The Evolving Mind-Body Alliance: A Handbook for Educators

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Studies in Education

Submitted in partial fulfillment

of the requirements for the degree of

Master of Education

Faculty of Education, Brock University

St. Catharines, Ontario

Abstract

This study examined anatomical and physiological connections between brain and body in relation to academic, physical, social, emotional, and behavioural benefits of physical activity in elementary schools. A handbook titled *The Evolving Mind-Body Alliance: Physical Activities Incorporated Into the Ontario Science Curriculum—A Handbook for Educators, Schools, and School Boards* was developed based on evidence that physical activity can benefit students academically, physically, and emotionally. Handbook activities were created for implementation into science lessons, with direct connections to the Ontario Science Curriculum (OSC), based on curriculum expectation goals and vision for science, including a majority of experiential learning and application knowledge, and because of students' difficulty relating to science's abstract concepts and terms. A review of literature about brain-body connection and benefits of movement in the classroom revealed that the defining features of the handbook should be (a) incorporation of physical activities that directly relate to the OSC, (b) require minimal resources to implement, and (c) provide a direct link to the OSC. Needs assessments were performed to gather the data from professionals in the field on the OSC and on the mandated daily physical activity. The handbook was reviewed by 3 teaching professionals in order to claim face validity of the document. The results of the project indicate that the handbook which was produced meets its goals of creating a product that is easy to use, practical, and effective for both educators and children in promoting the awareness of the brain-body connection and importance of learning through movement.

Acknowledgements

This research project has been completed with the encouragement, support, and guidance of the compassionate and thoughtful people around me during this unforgettable journey.

First and foremost, my utmost gratitude to Dr. Michael Savage whose devotion and genuineness I will never forget. You have mentored me; showing me the way to success through obstacles in completion of this research project. You are truly a remarkable person and I am privileged to have worked alongside of you.

I am exceptionally thankful to my second reader, Dr. Ann-Marie DiBiase; your input and guidance was much appreciated. You inspire me through all you do and have done for me. I am extremely grateful for the time and effort you put forth despite your busy schedule.

My utmost appreciation goes to my family for their astonishing love and support throughout my life. I thank my parents, Darrell and Gina, for their faith in me and remarkable care. You have allowed me to become more than I have ever imagined. It was under their watchful eye that I gained so much inspiration and ability to tackle challenges head on. I would also like to thank Keaton and Jenna for your incredible fun spirited personalities that brought nothing but fun and smiles as I travelled through this educational journey.

Finally, I like to thank Jordan for his miraculous, inimitable support and care. You kept me determined, balanced, and gave me strength throughout this journey. Bringing laughter, love, and devotion along with your endless understanding, compassion. and hard work have made this a success.

I am extremely grateful for these people who play a big role in my life!

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CHAPTER ONE: INTRODUCTION

We were born to hunt and gather, relying on physical power and intelligence to survive, but through evolution our society has engineered movement right out of our lives (Ratey, 2008). This is a major threat to our health and ultimately our survival. Physical activity (PA) not only positively influences our body but also our mind and emotions. This is the new epidemic arising amongst us jeopardizing humans' physical and mental well-being. It is beginning from a young age and accumulating into adulthood, placing strain on the overall health of the individual, of society, and resources. The rapidly increasing rate of children developing cardiovascular and respiratory diseases is astonishing. The most striking aspect of this increase is the substantive attribution to the frequency of obesity and overweight students, which is becoming a damaging epidemic.

The percentage of overweight students in our schools has tripled since 1980 due in part to lack of physical activity, and many children are showing early signs of heart disease as young as 5 and 10 years of age (National Association for Sport and Physical Education [NASPE], 2006). Obesity and overweight students are at a significantly higher risk for developing disease, illness, and emotional disorders. In essence, physical inactivity leads to obesity and overweight students whose overall well-being is at extreme risk. As Onywera (2013) observes, many students unfortunately do not participate in daily physical activity (DPA) because schools' priorities are focused in academics despite the numerous benefits physical activity has on academic success. Unfortunately, many educators, in my experience, do not make daily DPA a priority in the classroom. Twenty minutes of DPA was mandated by the Ontario government in October 2006 for publicly funded schools in order to provide students with a healthier place to learn and to improve student achievement. This demonstrates that the government and school boards recognize

the benefits and need for activity in student learning. Despite the lack of activity among today's students, many of them have an innate desire to move and be active.

The purpose of this project was to develop a handbook for educators, specifically for grade 4, with movement activities that directly relate to the Ontario Science Curriculum (OSC). Science tends to have abstract concepts and terms that are more difficult for students to relate to, therefore I chose to implement physical activity into this subject in order to aid in students comprehension of abstract terms versus worksheets. After examining literature about the brain-body connection and benefits of movement in the classroom, it became apparent that a defining feature of the handbook should be the incorporation of physical activities that directly relate to the OSC and require minimal resources to implement. The focus of the handbook is to promote the awareness of the brain-body connection and importance of learning through movement. Needs assessments were performed to gather the data from professionals in the field on the OSC and on the mandated DPA. To assess the face validity of the handbook (Creswell, 2013), three teaching professionals provided critical feedback regarding the structure, clarity, accessibility, practical application, and overall effectiveness of the handbook following the development of the first draft. The feedback was applied to the final product.

Background and Rationale

For years, centuries even, the mind, body, and emotion have been treated as separate entities. We now realize there is a strong link and connection between the mind and body, not just physically, but psychologically as well (Weiss, 2001). Kuczala (2010) explains,

> The brain and body have unfortunately been separated for both medical and educational purposes for far too long. The body is simply an outward extension of

> the brain. Incorporating the body as a tool for learning provides the students a simple and efficient means to learn and remember content. (p. 8)

The brain is the insatiable organ we have and we must fuel it with discovery, content, and creativity which can be accomplished through physical activity and movement. According to Blaydes (2000), there are three terms for movement: movement, physical activity, and exercise (as cited in Fede, 2012). Movement is described as the navigation of one's environment. Physical activity (PA) is any movement of skeletal muscle that uses energy. Finally, exercise is PA that is planned or repetitive. In terms of this paper, physical activity, exercise, and movement will be used interchangeably and will refer to any physical movements associated with an increase of energy expenditure.

Researchers found that the part of the brain that processes movement is the same part that processes learning (Jensen, 2005). The process of learning through movement is a recognized and established teaching method (Soltoggio, & Lemme, 2013). Being able to physically embody the experience of learning enhances students' understanding, memory, attention, mood, and overall well-being (Clements, 2006; Courchesne & Allen, 1997; Ratey, 2008). This is attributed to the increase in senses stimulated; students learn better in multi-sensory classrooms. Active participation increases retention after 2 weeks by 40% (Medina, 2009). Incorporating physical activities into the classroom and curriculum means that you are bringing the material alive to the learners.

Purpose of the Project

The purpose of this project was to provide elementary educators, focusing on grade 4, with movement activities that directly relate to science in the Ontario school curriculum. These movement activities are designed to benefit the students' overall well-

being, as well as enhance kinesthetic learning modality. The process of learning through movement activities and their effect on students' academic and personal well-being is a critical topic. Incorporating movement into lessons it gives the students purpose and experience to relate back to. Moving and performing activities while learning also promotes social interaction. By using the body students can express their knowledge through the foundational and natural learning process (Burrill, 2011). Providing another way of learning information can reduce stress that children have regarding academic performance, as well as promote healthy self-esteem and body image. Through acknowledging and accepting what the body can do, the students can become more confident in their abilities. The activities are designed to benefit the students' overall well-being in the dimensions of health, as creating a holistic student is the goal for educators.

Objectives of the Handbook

The primary purpose of my research was to gain perspectives and knowledge on the feasibility and impact of my handbook, *The Evolving Mind-Body Alliance: Physical Activities Incorporated Into the Ontario Science Curriculum—A Handbook for Educators, Schools, and School Boards.* The handbook was designed to: (a) inform educators of the vast benefits of incorporating physical activities into the classroom day, (b) provide educators with physical activities that directly relate to the OSC (which can be adapted for many cross curricular connections) that will aid in furthering students comprehension and academic success, and (c) require minimal resources, equipment, and cost to teachers, schools and school boards. The objectives of the handbook were achieved through theoretical and empirical research on the brain-body connection in

youth and adolescents, the results of the needs assessment surveys and observations, along with examination and application of other resources, including the Ontario Ministry of Education documents, which all contributed to the creation of the handbook.

The development of the handbook involved observations of current resources being used in the classrooms, and an exploration of student and teacher perceptions of what they would like in the handbook. Inherent to this research study was the exploration of teachers' and students' understanding of movement in learning, expectations for schools, and the relationships that they have with their bodies. Factors that facilitate and/or impeded these activities were also explored, as well as recommendations for movement to be incorporated into the curriculum and there effect on engagement and participation of the students. There is a strong need for new and recent research in this field (Wood, 2008). My handbook, *The Evolving Mind-Body Alliance*, may help eliminate and address the problem of the rising rate of obese and overweight students because the movement activities directly relate to the curriculum; therefore students are learning and moving all at the same time.

Theoretical Framework

Many theorists have established this notion of physical movement enhancing learning and comprehension. Edgar Dale (1969) was one of the early theorists who developed a theory regarding instructional design and the learning process. Dale's Cone of Experience theorized that learning retain a vast amount more when doing or performing versus reading or hearing. Dewey contributes to this notion by insisting that students must be treated as participants in life, not just spectators of life (as cited in Chee, 2011). Kolb's (1984) learning theory also describes this concept as learning through

experiences (or experiential learning), which includes physical movement. Gardner's (1999) furthered this view in his theory of multiple intelligences recognizes learners as bodily-kinesthetic learners who use their whole body to express knowledge (Fede, 2012). Presently, this concept of "learning by doing" is known as "experiential learning" or "action learning" (Anderson, n.d., p. 1). Providing physical movement in the learning process not only allows differentiated instruction for the students but also implicit learning, which Lengel and Kuczala (2010) state is the preferred way for the brain to acquire information. The theoretical framework will be furthered discussed in chapter 2.

Contribution to the Advancement of Knowledge

This research provided insights about students' learning process and perspectives related to the educational experiences of integrating physical activity with academic activities to aid in comprehension and understanding, with special attention to the overall well-being of students as well as teachers. Ideally, these insights about how educators can assist in optimizing the school experiences for students, as well as recommendations associated with improving overall well-being and learning strategies will result in stronger students who recognize the importance of developing both sides of the brain.

Outline of Remainder of the Document

Chapter 2 contains a review of related literature that was used to guide the development of the handbook. This literature review will be addressing the theoretical framework, anatomy and physiology behind the brain-body connection, the need for physical activities, the academic benefits of physical activities, the emotional, social, and physical benefits of physical activity, the OSC, and the teaching methods behind incorporating physical activities into classroom lessons.

Chapter 3 explains the methodology followed in order to develop the handbook. This chapter begins with a rationale of the handbook. Then the research design is outlined; this includes the needs assessments gathered from educators in the field along with a review of the handbook by educators who provided formative feedback which was considered and in some cases added to the final draft of the handbook. This is followed by a discussion of the limitations of the project.

Chapter 4 contains a copy of the handbook, *The Evolving Mind-Body Alliance*. The beginning of the handbook provides professionals with necessary background information including the importance of physical activity and the benefits associated with incorporating physical activity into the classroom, how the handbook is a resourceful tool, general considerations when using the handbook lessons, an outline of the activities in the handbook with their curriculum connection, and sample worksheets/assessments for a few of the activities. The majority of the handbook focuses on providing educators with 10 physical activities that directly relate to the OSC and how these lessons can be adapted into other grades and subjects. The aim of the handbook activities is to improve students' comprehension of concepts. Each activity provides educators with an overview of how to run the activity, the curriculum connections, assessments, how the activity can be adapted for other grades and subjects, and any necessary resources for that activity. The handbook concludes by providing references and resources to aid in implementing physical activities that relate to the curriculum into the classroom and school.

Chapter 5 presents the summary, discussion, and implications associated with the completion of the handbook. This chapter begins by providing a brief summary of the process of the project as well as the project itself. The discussion reflects upon the overall

process of completing the project. Finally, implications associated with this handbook are examined, and suggestions for further resource development and research are provided.

Definition of Terms

- *Brain-derived neurotrophic factor*: A growth factor in the neurotrophin family that supports and participates in cellular maintenance and in activity-dependent plasticity, such as learning and memory (Adlard, Perreau, & Cotman, 2005).
- *Brain plasticity*: The notion that our brains neurons can grow and change throughout our life. Also referred to as neuroplasticity (Jensen, 2005).
- *Explicit learning*: Learning that occurs on a very conscious level and, in a school setting, often happens through reading, listening, discussion, lecture, and work sheets (Kuczala, 2010).
- *Implicit learning*: Is the brain's preferred way to acquire information yet most school learning happens through explicit channels. Implicit learning often happens through movement, emotions, and life experiences (Kuczala, 2010).
- *Long-term potentiation (LTP)*: Physical process of learning. It means a neuron's response to another neuron has been increased. It has "learned" to respond. Through LTP the connection between the neurons is strengthened which is required for learning (Jensen, 2005).
- *Mind-body alliance*: The physiological, anatomical, and spiritual connection between the body and the brain.
- *Neurotransmitters (NT)*: Circulating brain chemicals that attribute to the brain's common network and play a role in simulating movement and emotions (Jensen, 2005).

- *Neurotrophin*: Secreted factors that influence growth, survival, and other functions of neurons. Some neurotrophins can also be referred to as neurotransmitters (Kafitz, Rose, Thoenen, & Konnerth, 1999).
- *Physical activity*: All forms of movement associated with an increase of energy expenditure; including spontaneous physical activity and organized non-competitive forms of physical activity, such as exercise, physical education classes, and sport (Trudeau & Shephard, 2010).
- *Self-esteem*: Is the "feeling of self-appreciation" and is an indispensable emotion for people to adapt to society and live their lives (Hosogi, Okada, Fujii, Noguchi, & Watanabe, 2012).

CHAPTER TWO: REVIEW OF RELATED LITERATURE

This chapter outlines the relevant literature review about the brain-body connection with the intent of creating a resource handbook that provides physical activities that directly relate to the OSC that will assist educators in improving students' comprehension of concepts and content. This chapter is divided into sections addressing the relevant literature on the anatomy and physiology behind the brain-body connection; the need for physical activities; the academic benefits of physical activities; the emotional, social, and physical benefits of physical activity; the OSC; and the teaching methods and theory behind incorporating physical activities into classroom lessons. The final section provides a rationale for creating an educator handbook with physical activities directly related to the OSC to develop students' academic, social, physical, and overall well-being.

Theoretical Framework

As educators, we are aware of Gardner's (1999) theory of multiple intelligences in order to reach the needs of various learners in the classroom. Gardner recognizes one of the type of learners are the bodily-kinesthetic learners who "use their whole body to express themselves and have specific physical skills such as, coordination, balance, strength and speed" (as cited in Fede, 2012, p. 17). A study undertaken at the University of Illinois found that these types of learners make up about 50% of secondary students, which means that half of our students are not benefiting from learning in a traditional/passive setting (as cited in Crewdson, 2013). In essence, we are kinesthetic learners. Learning isn't all in our heads, and our brains don't sit disembodied in a bucket. Our mind and bodies work together to help us pay attention, solve problems, and

remember solutions (Weiss, 2001). Movement and physical activity can enhance optimal learning states (Jensen, 2005).

In order to enhance our framework and educational practices in the classroom we must incorporate this kinesthetic method of implicit learning; Lengel and Kuczala (2010) state that such learning "often occurs through movement, life experiences and emotions, and is the preferred way for the brain to acquire information" (as cited in Fede, 2012, p. 17). Personal experience and research have concluded that adding movement into learning enhances engagement, places the concept in context, and gives purpose to a students' learning (Wood, 2008). Differentiating instruction is important in the teaching method because of the diverse individuals in a classroom and including movement provides this instruction which increases attention, retention, and motivation in the learning process (Lengel & Kuczala, 2010; Ratey, 2008).

Dewey insists that students must be treated as participants in life, not just spectators of life (as cited in Chee, 2011). The beginning of self occurs through three stages of role taking: play, game, and other (Mead, 1982). When carrying out physical activities in the classroom, the students are essentially performing. Through performance individuals are celebrated and a way to get to know themselves, others and the world around them. Performance is communicative, productive, purposeful, incorporates intellectual inquiry, reflection and evaluation (Chee, 2011). Based on Dewey's (1938/1991) theory of "learning as inquiry" and on Thomas and Brown's (2007) theory of "learning to be," Chee, Loke, and Tan (2009) have produced a theory of "learning as becoming." Learning as becoming is essentially learning through physically embracing the content and physically experiencing the concepts.

Movement in learning is experiential. As noted earlier, Kolb's (1984) learning theory states that experiential learning is learning through experiences, by thinking, planning, watching, reflecting and physically performing. By engaging in these activities, learners can construct meaning in a way unique to themselves, incorporating the cognitive, emotional, and physical aspects of learning (Oxendine, Robinson, & Willson, 2004).

The experiential learning cycle can also be a tool to monitor student-learning styles. According to Susan Barduhn (1998), "One can also look at an individual trainee's experience of that course, and note how his/her individual learning styles impact on different parts of the cycle to enable some aspects to provide a richer experience than others" (pp. 26-27). When the educator uses a more experientially based teaching method, more students are included because of the incorporation of more learning styles than the traditional lecture style lessons.

Dale's (1969) Cone of Experience is a model that incorporates several theories related to instructional design and learning processes:

> During the 1960s, Edgar Dale theorized that learners retain more information by what they 'do' as opposed to what is "heard," "read" or "observed." His research led to the development of the Cone of Experience. Today, this "learning by doing" has become known as "experiential learning" or "action learning." (Anderson, n.d., p. 1)

Based on Dale's Cone of Experience, students retain 90% of what they do or experience in performing a task versus 0-10% of what they read and hear. The bottom of cone that is "doing" or "action-learning" is listed as direct purposeful experience because it closely

relates to real everyday situations, and show that "people learn best when they use perceptual (sensory) learning styles" (Anderson, n.d., p. 2). As educators express their instructional method it is important to keep in mind how the students learn and where the strength in knowledge retention appears. Dale's cone of experience can be used to aid educators in making decisions about resources and activities they are going to use in their classroom.

The Mind-Body Alliance: Anatomical and Physiological Connection

The brain is a complex, extraordinary, and powerful organ and muscle that ultimately controls our whole body. The physiological and anatomical link between the brain and the body is far more extensive then the brain strictly being located within the body. Over the years many researchers have established and supported these extensive links between the brain and physical bodily movement, starting with the ancient Greeks (Schmahmann, 1997, as cited in Rasmussen & Laumann, 2013; Weiss, 2001). Firstly, the anatomy of the brain, including the structure and function, will be discussed followed by neuronal connections and hormones that influence, or are influenced by, motor actions, specifically physical movement and exercise. The brain can be divided into are three main divisions: the forebrain, the cerebellum, and the brainstem, as shown in Figure 1. The forebrain includes the cerebrum and diencephalon.

The cerebrum contains the cerebral cortex and the basal nuclei. The cerebrum is the largest part of the brain and is divided into two halves, called the left and right cerebral hemispheres. The two hemispheres are connected by a bundle of nerve fibres called the corpus callosum, which allows for communication between both hemispheres (Canadian Cancer Society [CCS], 2014).

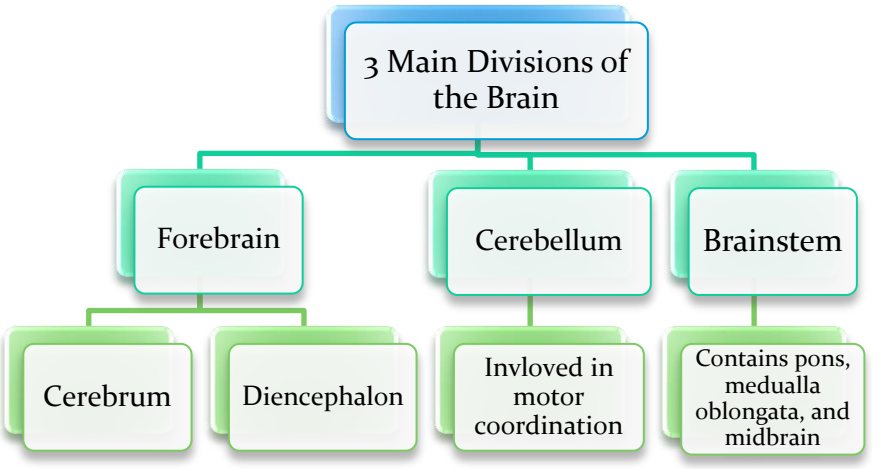

Figure 1. The three main divisions of the human brain.

The right half of the cerebrum (right hemisphere) controls the left side of the body and vice versa. The cerebrum's outer layer is called the cerebral cortex or grey matter, which is most advanced area of the brain containing one billion neurons and one trillion synapses (Lundy-Ekman, 2007) and is divided into four lobes, that are associated with a specific function: frontal lobe, parietal lobe, occipital lobe and temporal lobe (Lundy-Ekman, 2007; Rosenbaum, 2010). The brain has neurons and glial cells, in which areas of the brain communicate within themselves and with other parts of the body (Jensen, 2005). The cerebral cortex is the area of the brain where nerve cells (neurons) make connections, called synapses that control brain activity and is responsible for perception, ideas, emotions, memory, and motor control. The inner area of the cerebrum contain neurons, which consist of a cell body that with fingerlike input extensions called dendrites and a single output called an axon, which relay information between the brain and spinal cord (CCS, 2014; Jensen, 2005). Another part of the cerebrum is the basal ganglia, a cluster of structures in the center of the brain. It functions to coordinate messages between multiple areas of the brain (WebMD, 2009). The second part of the forebrain is the diencephalon. The diencephalon contains the thalamus and hypothalamus. The thalamus has two lobes and acts as a relay station for almost all information that comes and goes between the brain and the rest of the nervous system (CCS, 2014). The hypothalamus plays a role in controlling body temperature, hormone secretion, blood pressure, emotions, appetite, and sleep patterns (CCS, 2014).

The second main division of the brain is the cerebellum. It is located under the cerebrum near the back of the brain. It is very similar to the cerebrum, as it contains two hemispheres and contains grey and white matter. The cerebellum is involved in motor

coordination via feedback loops, which includes posture, balance, reflexes and complex actions (CCS, 2014). The feedback loops collect sensory information from the body and transfer the information to the cerebrum when will analyse and decide on the next motor behaviour to execute. This signal will then be send to the peripheral nerves to perform. When we perform exercises or physical activities, the fact that the cerebellum coordinates motor movements, means that we are also working many areas in our brain. The more often we activity these areas the strong the connections become, therefore the more we move, the stronger our brain. The third division of the brain is the brainstem, which contains the pons, medulla oblongata and midbrain (Lundy-Ekman, 2007).

The brainstem is a bundle of nerve tissue at the base of the brain, which connects the cerebrum with the spinal cord. Motor and sensory neurons travel through the brainstem allowing for messages to be sent between the brain, the spinal cord, and different parts of the body. The brainstem coordinates motor control signals sent from the brain to the body and controls life supporting autonomic functions, such as breathing, of the peripheral nervous system (Bailey, 2014b; CCS, 2014). The medulla oblongata controls autonomic functions and is where neurons from the midbrain and forebrain travel through. The pons connect the cerebral cortex with the medulla oblongata and serves as a communication and coordination center between the two hemispheres of the brain (Bailey, 2014a). The midbrain connects the hindbrain and the forebrain**.** The primary area of focus for this review will be on the cerebral cortex. Figure 2 displays the extreme proximity of the area that controls movement (primary motor cortex) and the area that controls thought and processes learning—primary somatosensory (Middleton & Strick, 1994; Weiss, 2001).

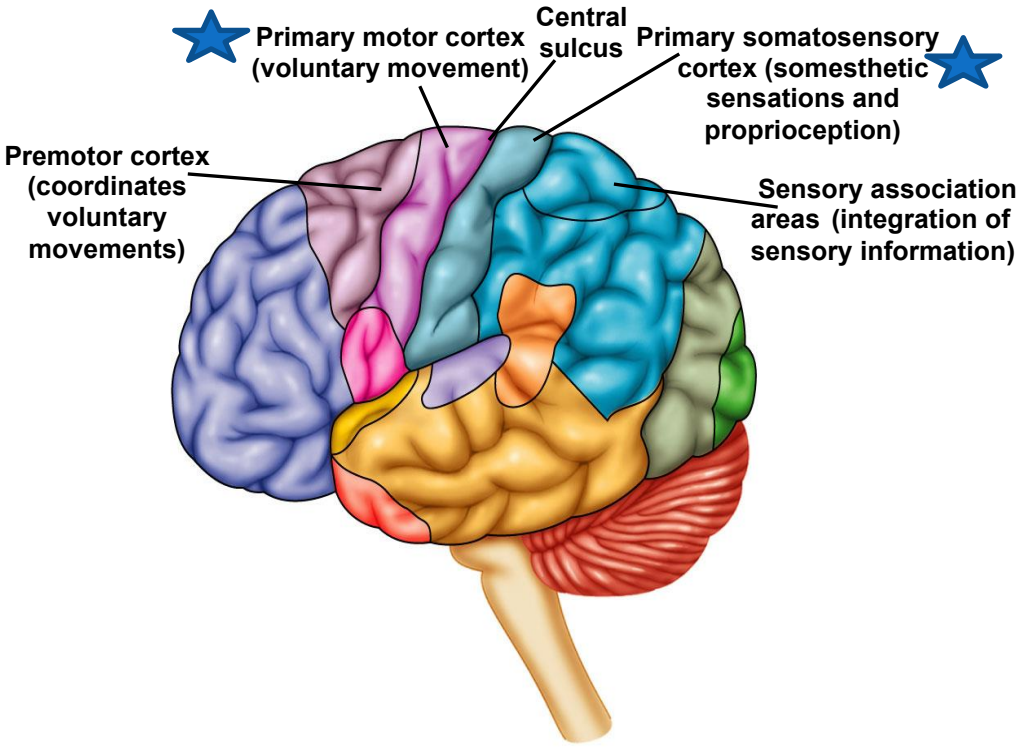

Figure 2. Functional areas of the cerebral cortex. Adapted from Rosenbaum (2010).

Overall our brain responses are similar to other muscles in the body, as it grows with use and withers with inactivity (Ratey, 2008), as the blood flow increases when the brain is in use and when it is not in use the lack of blood flow causes atrophy. Physiologically, when we move and perform physical activity our oxygen and blood flow increase, as does the cerebral blood flow and oxygen to the brain (Geyer, as cited in Weiss, 2001).When a body is physically active the heart rate increases; because of this blood flow increase. The blood flow increases because the muscles are in need of the nutrients located in the plasma and oxygen in the blood. Therefore when a body is physically active the oxygen flow to areas in the body increases. Geyer (as cited in Weiss (2001) states that when a body is active the increase in cerebral blood flow to the brain influences the growth and development of capillaries, permits collateral circulation, and aids in the release of dopamine and serotonin (two essential neurotransmitters to help sustain attention and the ability to concentrate). The bloodstream creates a common linkage for circulating brain chemicals (neurotransmitters) and hormones (Jensen, 2005).

Ratey (2008) refers to the neurons in our brains as connected through branches and when we exercise the branches grow and bloom with new buds, therefore an increase in brain function at a fundamental level. A vast majority of the signaling in the brain is carried out by two neurotransmitters (NT) that balance each other out; glutamate and gamma-aminobutyric acid (GABA). Glutamate is the primary excitatory (stimulates activity) and GABA is the main inhibitory (represses activity) NT in the cortex (Petroff, 2002). While thinking, talking, and processing glutamate receptors function actively to take up glutamate therefore you need glutamate for learning, and functioning. Based on Mullen (2013) the more intelligent you are, the more glutamate receptors you have on

your cells. GABA is very prominently involved with the neuronal connections of language. It actually puts the gaps between words (Mullen, 2013). When you have too much or little of these neurotransmitters serious problems can arise, as too much or little of anything can harm the body and brain. When glutamate delivers a signal between two neurons that have not been in connection before, the pump is activated. "The more often the connections are activated the strong the attraction becomes and the easier they fire or initiate" (Ratey, 2008, p. 37).

The regulatory neurotransmitters in the brain are serotonin, dopamine, and norepinephrine (Ratey, 2008). These NTs are very powerful and can instruct a neuron to make more glutamate, can override or amplify signals, and alter the sensitively of a receptor (Ratey, 2008). These NTs are the gate-keepers who balance the information and neurochemicals coming in and out of the brain. Norepinephrine influences attention, perception, motivation and arousal, whereas dopamine influences learning, reward, attention and movement (Ratey, 2008). Serotonin plays a role in learning and memory, specifically in developing and retrieving short-term memories ("Effects of Physical Exercise," 2012).

Dopamine neurons are located mainly in two nuclei of the midbrain. Axons of the dopamine neurons project to the pathway that is responsible for movement behaviour, and axons also project to the entire cortex which is involved in cognition and reward responses (Lin & Kuo, 2013). The axons of norepinephrine neurons innervate the whole cerebral cortex, various subcortical areas, cerebellum and brain stem (Bouret & Sara, 2005). Serotonin receptors are mainly located in the cortex and basal ganglia, and are responsible for producing the neural impulse (Hoyer et al., 1994). The axons of serotonergic neurons, primarily from the median and dorsal raphe nuclei, project to the

entire CNS (Lin & Kuo, 2013).

During physical activity the release of dopamine and serotonin increases, providing the individual with a feeling of pleasure and happiness. Exercise increases dopamine levels in the brain through a calcium-dependent process that regulates numerous brain functions (Sutoo & Akiyama, 2003). Exercise not only moderates the direct action of dopamine, but also protects dopamine neurons against toxic attacks (Lin & Kuo, 2013). Norepinephrine significantly enhances memory performance immediately after a single bout of aerobic exercise (Segal, Cotman, & Cahill, 2012). Based on the increased activity of NE by exercise, it is suggested that there is a potential linkage between NE and exercise-enhanced cognitive function (Lin & Kuo, 2013). Brain serotonin levels are elevated following physical activity through two mechanisms: (a) Motor activity increases both the release and synthesis of serotonin; (b) Exercise increases levels of tryptophan in the brain, which is then used to manufacture greater amounts of serotonin ("Effects of Physical Exercise," 2012).

Biologically, depression and feelings of sadness, stress, low self-esteem, and other mood disorders are causes by a lack of or low levels of serotonin (Dayan & Huys, 2008). In addition to these pleasure hormones, exercise enhances brain aminergic synaptic transmission (Paluska & Schewenk, 2000, as cited in Motta et al., 2012). This enhanced transmission leads to an increased level of arousal and attention. This was discovered based on the endorphin hypothesis "that suggests beta-endorphins are produced throughout the body during exercise, decreasing pain and creating a euphoric state" (Motta, McWilliams, Schwartz, & Cavera, 2012, p. 230). Smith (2013) furthers this connection by stating that the physiological and neural systems that manage emotional

responsiveness overlap with the systems that manage muscular activation and motor behaviour. Concluding that when we exercise or are physically active the neuro-endocrine response to our brain positively affects our mood and emotions, therefore the more often we can move the better it is for our emotional state and development. A way to achieve this daily is by bring movement into the classroom with will positively affect the students and educators mood and emotional well-being.

It is evident through research that humans grow neurons daily in the learning and memory centers of the brain by increasing the connections between the neural pathways and forming new structures (Gill, 2012; Weiss, 2001). This notion that our brains neurons can grow and change throughout our life is referred to as neuroplasticity, and has been recently researched (as cited in Jensen, 2005). This ability of our brains to change is directly influenced by ourselves, as we have the capacity and choice to change our brains (Cacioppo, Berntson, Sheridan, & McClintock, 2001, as cited in Jensen, 2005). In saying that, it can be concluded that our brain is always a work in progress as it is always changing based on the way we live our lives.

A major factor that influences our brain is our body's activity level. Movement increases the factor that facilitates neuroplasticity (Weiss, 2001). Although many molecular factors facilitate neuroplasticity, brain-derived neurotrophic factor (BDNF) has emerged as the key facilitator of neuroplasticity involved in motor learning and activity-depended plasticity, such as learning and memory (Adlard et al., 2005; Mang, Campbell, Ross, & Boyd, 2013). In the brain, BDNF is in the blood and active in the hippocampus, cortex, and basal forebrain, areas vital to learning, memory, and higher thinking (Yamada & Nabeshima, 2003). BDNF gathers near synapses and is unleashed when blood starts to

pump. BDNF enhances brain function and neuroplasticity, as stated above, and when the body is physically activity the up-regulation and production of BDNF increases (Mang et al., 2013). Therefore there is evidence to support the increase of BDNF through aerobic exercise, which enhances the learning and memory processes in the brain (Mang et al., 2013). In the classroom, providing opportunities to get up and move our brain chemicals that improve learning will result in further academic achievement.

When our blood starts to pump during physical activity, there are chemical proteins from the body that are called on to help. These hormones are insulin-like growth factor (IGF-1), vascular endothelia growth factor (VEGF). and fibro-blast growth factor (FGF-2) (Ratey, 2008). IGF-1 aids in neuron binding, FGF-2 and VEGF build new capillaries and expand the vascular system in the brain (Ratey, 2008, p. 78). You can imagine this as a production line; the more people and bigger conveyer belt, the more efficient the flow. The prefrontal cortex is a key player in running the brain. The prefrontal cortex is located at the front most part of the cerebral cortex, located right behind your forehead (Bailey, 2014c).

This area functions in the regulation of complex cognitive, emotional, and behavioral functioning including decision making and higher level thinking (McGill University, 2014; “Prefrontal Cortex,” 2014). In organizing activity, both mental and physical, the prefrontal cortex must attend to the current situation and all executive functions (Ratey, 2008). Endo et al. (2013) have conducted research based from previous studies finding that exercise influences prefrontal functioning. Endo et al. (2013) have further supported that performing physical activity, for only 15 minutes, can increase the oxygen to the prefrontal cortex which in turn enhances the cognitive functioning.

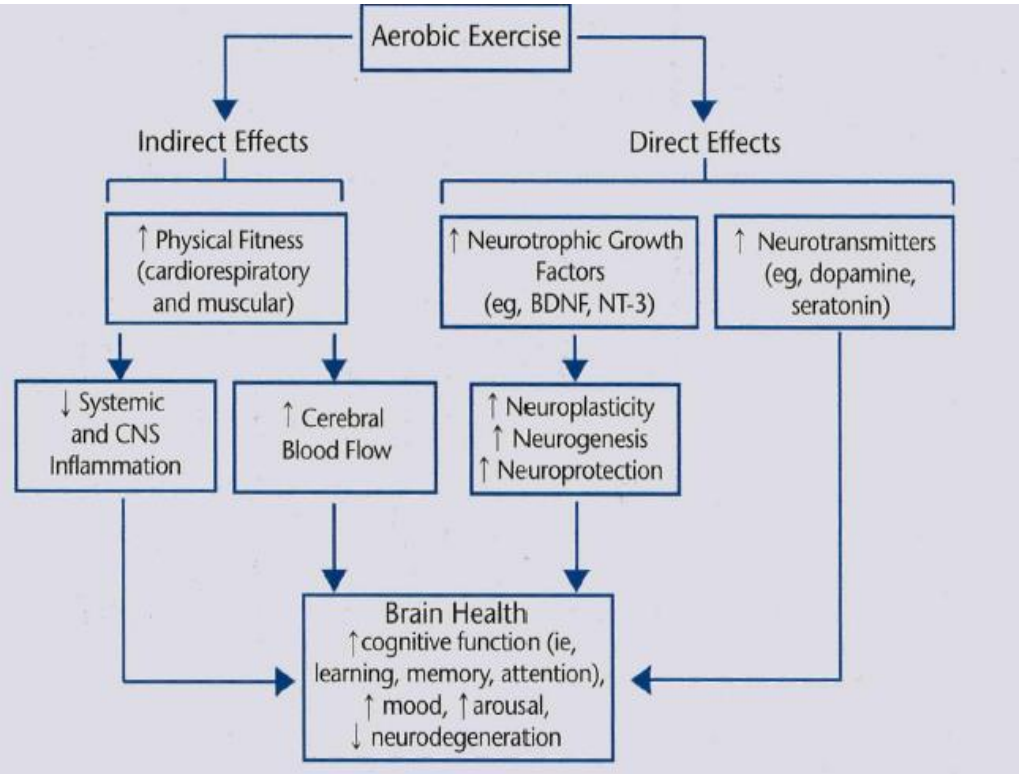

Figure 3. Positive effects of aerobic exercise on the brain (Mang et al., 2013, p. 1709).

Our brain is like a system of gears, one affects the other and they all work together to execute a function. The brain learns in five steps:

1. Input arrives from the five senses or internally from imagination/reflection (activated by thinking or memory) (Jensen, 2005; Ratey, 2008).
2. The input is processed in the thalamus and other specific areas for further processing.
3. Quickly the brain forms a rough sensory impression of the data. Frontal lobes hold new data in short-term memory for 5 to 20 seconds (Jensen, 2005).
4. Most of the info is filtered and never gets stored. If it's worth a second consideration, new explicit learning is routed to and held in the hippocampus. The hippocampus receives new input from working memory, cross-references it with existing memories, forms new associations and reports back to the boss, the prefrontal cortex (Ratey, 2008).
5. When the information is processed in the hippocampus, its value is determines. It is valuable it will be organized by the hippocampus and stored in the cortex. (Jensen 2005).

How exactly does this process work? The mechanics of learning starts when the brain is called to take on new information it causes activity between the neurons (Ratey, 2008). A normal functioning neuron is continuously firing, integrating and generating information (Jensen, 2005). The more activity or the bigger "spark" the new information causes the stronger the attraction becomes between the neurons and the easier it is for the signal to fire and make the connection (Ratey, 2008). Information flows in two directions in the cortex, the receiving neurons and the neurons that provide the information. This

information flow or “dialogue” between neurons produces internal feedback (Jensen, 2005). There are NTs located in the neuron’s axon (body of the neuron cell) that are either excitatory or inhibitory. If the sum of the NTs reaches a specific threshold (more excitatory than inhibitory) then the NT and impulse will continue on the journey.

We know that glutamate functions as the primary excitatory NT, and is needed for learning and functioning, as BDNF is expressed in glutamate (Cotman & Berchtold, 2002). When the excitatory NT, glutamate, in the axon reaches the threshold it will be sent across the synapse to receptors on the receiving side. The connection is extremely strong because when the receiving receptors are at rest the gradient is large, which increases the affinity for glutamate (Gibala, MacLean, Graham, & Saltin, 1997; Van Hall, Saltin, & Wagenmakers, 1999). This process is repeated as it moves on to the next cell, as the firing continues “genes inside the neuron’s cell nucleus are turned on to produce more building material for the synapse and it is the bolstering of this infrastructure that allows the new information to stick as memory” (Ratey, 2008, p. 39).

Based on Mullen (2013) the more intelligent you are, the more glutamate receptors you have on your cells. The question becomes, how can we increase our glutamate receptors? Simply increase BDNF, which is expressed in glutamate. BDNF improves brain plasticity in areas vital to learning and memory, improves neuron functions, encourages their growth and strengthens and protects them (Adlard et al., 2005; Brunelli et al., 2012; Yamada & Nabeshima, 2003). The way to increase BDNF is to be physically active, as BDNF is released when our blood starts to pump (Adlard & Cotman, 2004; Adlard et al., 2005; Mang et al., 2013).

Supporting this fact, Susan Patterson found through experimentation with rats, that without BDNF you lose your capacity for long-term potentiation (LTP) (as cited in Ratey, 2008). LTP is the physical process of learning (Jensen, 2005). Foundation of LTP was built on the original work of Donald Hebb in 1949. LTP was first defined in 1973 (Bliss & Lomo, 1973), and since that time there have been numerous investigations that have explored this process of memory formation (Jensen, 2005). "LTP means a neuron's response to another neuron has been increased. It has 'learned' to respond. Each future event requires less work to activate the same memory network" (Jensen, 2005, p. 16). Learning requires strengthening of the attraction between neurons through this mechanism LTP (Jensen, 2005). When we exercise or are physically active the cells produced are better equipped to trigger LTP (Ratey, 2008). Stimulation increases brain function, as characterized both number of neurons and extend of their interconnections (Trudeau & Shephard, 2010).

In conclusion your brain and body are integrated as one; they depend and affect each other like a balancing scale. Exercising and being physically active prepares neurons in our brain to connect, strengthens connections, enhances neuroplasticity, and stimulates hormones and proteins in the blood that aid in overall optimal functioning of the brain and body (Ratey, 2008). Our muscles, including the brain, become stronger and more flexible the more you use them, therefore the more we can move the better our brain power can be (Ratey, 2008).

Exercise strengthens all key areas in the brain, such as basal ganglia, cerebellum, and corpus callosum (Jensen, 2005). All of this supports the notion that our brain and bodies are like the sun and moon; they belong, complement, work together, and without

one the earth could not function; consequently in order to improve our brains we must move our bodies (Weiss, 2001). Treating your body can transform the mind!

The Need for Physical Activity

We were born to hunt and gather, relying on physical power and their intelligence to survive, but through evolution our society has engineered movement right out of our lives (Ratey, 2008). This is a major threat to our health and ultimately our survival. Physical activity (PA) not only positively influences our body but also our mind and emotions. Physical activity benefits physical and cognitive abilities (Active Healthy Kids Canada [AHKC], 2012; Bürgi et al., 2011), such as problem-solving, perceptual skills, IQ, academic achievement, verbal tests, mathematics tests, creativity, decision-making, executive functions, speech and developmental level (Brockman, Jago, & Fox, 2011; Davis et al., 2007; Gleave & Cole-Hamilton, 2012; Gray, 2011; Singer, Singer, D'Agostino, & DeLong, 2009). PA also increases self-esteem and appear less likely to develop mental health problems while increasing social skills (Biddle & Asare, 2011).

Benefits of physical activity has been shown in all ages, and those who are active as children are more likely to continue to reap the benefits throughout their lives (Alpert, Field, Goldstein, & Perry, 1990; Colcombe & Kramer, 2003; Etnier et al., 1997; Hallal, Victora, Azevedo, & Wells, 2006; Taylor et al., 2004; Telama et al., 2005; Twisk. Kemper, & Van Mechelen, 2000). Active play is children's occupation; they grow and develop through physical movement and discovery (Piaget, 2007).

Canadian Society for Exercise Physiology (CSEP) in 2011 released the new physical activity guidelines, which state that "all healthy children (5-11yrs old) and youth (12-17yrs old) are recommended to get at least 60 minutes of moderate-vigorous physical

activity daily (MVPA)" (p. 5). These guidelines had more than 1,000 Canadian experts involved in the process, and they conclude that this is a minimum and the more physical activity the better.

Unfortunately, children and adults all over the world are not meeting the recommended DPA level (Kuhnhausen et al., 2013; Reed et al., 2013). How close are the Canadian children in reaching these recommendations? Quite far off, as Canadian kids were found not playing actively in their "free time" at lunch, recess, and after school, resulting in the children only getting 24 minutes of MVPA out of the possible four hours (Tremblay et al., 2010). This is an increasing epidemic and needs to be addressed and placed on top priority if we want to live a long, healthy life. This section will be outlining the need for physical activity in Ontario schools, addressing the Ontario DPA mandate, the health and physical education curriculum (HPE), barriers to implementation and suggestions for future direction.

The Need for Physical Activity in Today's Youth and Society

In 2003 one of every two adults in Ontario were overweight or obese (Ontario Ministry of Health & Long-Term Care [OMHLTC], 2004) similarly, the percentage of overweight students in our schools has tripled since 1980, and of the children born in 2003 one out of three will develop type 2 diabetes or cardiovascular diseases along with the many children who are showing early signs of heart disease as young as 5 and 10 years of age (Ball & McCargar, 2003; National Association for Sport and Physical Education, 2006) due to the lack of movement and poor diet. Available data suggest the prevalence of obesity is more related to a lack of physical activity than increased food intake alone (Ogden et al., 2006) and that physical activity counteracts the negative

effects of a poor diet (Molteni et al., 2004). This provides us with the notion that PA is the most influential modifiable lifestyle behaviour.

One quarter of Canadian children are now overweight or obese (AHKC, 2009, as cited in Patton, 2012) and the major contributing factor is the decrease in PA (AHKC, 2010). Childhood obesity affects the growth and development and contributes to health and psychosocial problems (Institute of Medicine, 2004) and a survey done in 2000 found that 56% of 12-19 year olds and 57% of 5-17 year olds were not active enough for optimal growth and development health (Craig, Cameron, Storm, & Beaulieu, 2002). Some of health consequences, as mentioned above, include increased presence of cardiovascular disease and type 2 diabetes (Ball & McCarger, 2003), consequently PA improves cholesterol, blood lipid levels, blood pressure, bone density and depression symptoms (AHKC, 2011; Janssen & LeBlanc, 2010).

Adiposity, low aerobic fitness and low levels of physical activity are all associated with a group of cardiovascular diseases in children, which represent a huge public health concern (Andersen et al., 2006; McLure, Summerbell, & Reilly, 2009; Tremblay et al., 2010). This increase in overweight and obesity and decrease in physical activity is the primary contributor to the rise in illnesses, which is placing a large strain on healthcare costs (OMHLTC, 2004).

The Active Healthy Kids Canada Report Card data on physical activity levels in Canadian children remains an F for the 6th consecutive year, as objectively measured data indicate that only 7% of children and youth are meeting Canada's guidelines of 60 minutes of physical activity a day (as cited in AHKC, 2012). Tremblay et al. (2010) performed a study across Canada on 6-19 year olds, measuring their step count and

comparing it to the recommended DPA guidelines. They were investigating whether 12,000 steps or 13,500 steps per day were close to the recommended daily activity. Results showed that 12,000 steps daily were closest to the recommended activity levels; however it should be noted that this is 12,000 steps *daily*. In regards to this recommendation Ontario students are averaging 11,815 steps per day (AHKC, 2010), below the recommended steps per day need to achieve optimal growth and development.

Overweight and obesity is known as the "new tobacco" (OMHLTC, 2004) as it becoming aware that being in this state is detrimental to your health and is continuing to increase in prevalence. Centers for Disease Control and Prevention (CDC) has revealed that the prevalence of overweight youth is increasing: for children age 2 to 5, prevalence increased from 5.0% in 1980 to 13.9% in 2004; for those age 6 to 11, prevalence increased from 6.5% to 18.8%; and for those age 12 to 19, prevalence increased from 5.0% to 17.4% (as cited in Reed et al., 2010). In addition, according to the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), more than 80% of individuals with Type 2 diabetes are overweight (as cited in Reed et al., 2010).

It is extremely evident that obesity and physical inactivity is on the rise in Canada and is a crisis we need to deal with (AHKC, 2011) as childhood obesity is one of the most dangerous health threats facing youth, considering that approximately 25 million kids are overweight or obese (Ogden et al., 2006, as cited in Reed et al., 2010).

The decrease in physical activity could be attributed to the low priority that Ontario school boards place on physical activity and health and physical education. In grade 1-8, the time allotted for PE is not mandated; however there is a mandate that students get 20 minutes of DPA. In secondary school there is not mandated physical

activity and only 1credit of HPE is required for graduation. In addition to this, there is a steady decline in number of Ontario elementary schools with physical education teachers (People for Education, 2004).

It is essential to start to educate and establish DPA routines with children because a majority of children who were overweight as children were obese as adults, especially if overweight began before 8 years old, and vice versa, obese adults were overweight children (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Physical activity should be encouraged throughout the student's day, however as an educator, during the school is our focus.

DPA and Health & Physical Education (HPE) Curriculum

School has been seen as a central environment to provide physical activity because all students get the opportunity to participate regardless of their socioeconomic status or family influence (Dwyer et al., 2008). Tremblay et al. (2010) and Garriguet and Colley (2012) researched and plotted to the average daily minutes of MVPA by activity tercile and time of day. All levels of activity reported the highest amount of minutes of MVPA during school hours (as cited in AHKC, 2012). As educators, it is our duty to provide students with the benefits of physical activity and health and physical education.

First off, the current main goals of Ontario education is increasing test scores in reading, writing and math; increasing graduation rates; and closing the achievement gap on tests score (Ontario Ministry of Education, 2014). However these narrow goals do know acknowledge the importance of health and well-being, which in turn increases academic achievement which leads to accomplishing these goals (Ontario Physical Health Education Association [OPHEA], 2005).

HPE curriculum was revised in 2010 and was based on the vision that "the knowledge and skills required in the program will benefit students throughout their lives and help them to thrive in an ever-changing world by enabling them to quire physical and healthy literacy, and to develop the comprehension, capacity and commitment needed to lead healthy, active lives and promote healthy active living" (PHE Curriculum as cited in AHKC, 2010, p. 63). However in the AHKC (2012) report card the HPE curriculum was given a C grade and research stated that only 31% of Canadian students receive regular PE from specialists. On the positive side, the grade of a C is an improvement from 2009-2011 in which physical education received a C-. The Ontario HPE Curriculum has no formal evaluation of how it is being implemented.

The Ontario Ministry of Education (2005) created and implement a policy in 2005/2006, Memorandum No. 138, which states "schools boards must ensure that all elementary students… have a minimum of twenty minutes of sustained moderate to vigorous physical activity each school day during instructional time" (p. 1). This is also referred to as the DPA mandate.

The goal of DPA is to "enable all elementary students to improve or maintain their physical fitness and their overall health and wellness, and to enhance their learning opportunities" (Ontario Ministry of Education, 2005, p. 1). DPA was implemented as part of government's Health Schools Program. OPHEA has created DPA training and support services for schools and teachers, which provide strategies and suggestions to applying DPA into the classroom day (Patton, 2012).

A majority of principals rate DPA programs at their school as good or excellent, and schools with specialists were more likely to respond positively (Patton, 2012). The

percent of principals that rate their DPA program as poor varies respectively to their location; central Ontario and the GTA about 28% rate their program as poor or needs improvement (Patton, 2012). Stone, Faulkner, Zeglen-Hunt, and Cowie-Bonne (2012) performed a study in the GTA on 1000 students found fewer than half were provided with DPA, and not a single child engaged in sustained moderate to vigorous activity for twenty minutes or more (People for Education, 2013a). Parallel, Patton (2012) results expressed that 16% of teachers reported "never" or "rarely" to conducting DPA, suggesting DPA is being viewed as optional rather than important. Only 15% of school administrators state that they integrate physical activity into other areas of the curriculum (Currie et al., 2012).

There are many challenges and barriers to effectively implementing physical activity and education, such as evaluating the effectiveness of DPA and this is recognized by OPHEA and OME (OPHEA, 2006, 2007). In addition the biggest barrier reported is the time to fit DPA in, an Ontario principal states "DPA is difficult to deliver when there's already so much pressure to fit other curricula into the day" (Principal, Elementary School, Kawartha Pine Ridge DSB, as cited in People for Education, 2013a, p. 14). These barriers are not as of big of an obstacle as some educators and administrator may think and possible solutions are simpler than you think.

Implications and Future Direction

Commonly reported barriers to implementing DPA and more health and physical education are scheduling with competing subjects, facilities, teacher training, space, and funding (Dwyer et al., 2008; Patton, 2012; Robertson-Wilson & Levesque, 2009).

Notable argument of the strict demands of academic subjects, the time required for DPA take time away from other content areas thereby detracting from academic success, however studies have shown that academic achievement does not suffer when time allotted to academic subjects decrease and physical activity time increases (Ahamed et al., 2007; Lindner, 2002; Trudeau & Shephard, 2008). Forty-five percent of educators claimed they "never" have enough time to plan DPA (Patton, 2012). However PA and learning is hardwired into the brain circuit, our brain and mind are connected as one (Ratey, 2008). PA actually improves academic success, along with many other aspects of well-being (AHKC, 2011; Davis et al., 2007; Strong et al., 2005). In complement, children absorb information through socialization with their peers and teachers (Patton, 2012).

Physical activity is placed as a low priority in many schools. Many educators ignore, misinterpret and do not fully understand the benefits of the implementation of DPA (Health & Physical Education Council, 2005). Therefore training and education is needed, along with having PE specialists teach and conduct HPE and DPA in the schools. 63% of students reported that most PE classes were taught by a classroom teacher (Dwyer et al., 2008). People for Education's (2013a) *Annual Report on Ontario's Publicly Funded Schools* notes that 45% of elementary schools have a specialist health and physical education teacher; one third are in schools part-time. These specialists produce better health outcomes and enhanced academic achievement, from school-based physical education programs (Bailey, 2006; Kreimler et al., 2010; Telford et al., 2012).

Despite the lack of training and education provided for teachers, 85% of teacher's state that the resources from OPHEA and other organizations are sufficient and at their

disposal (Patton, 2012). In regards to the space issue, Reed et al. (2010) performed a study of 155 grade 3 students from six classrooms. Three classrooms were randomly assigned to the control or experimental group. The experimental group integrated physical activity into their core curricula approximately 30 minutes a day, 3 days a week for 3 months and measured level of activity through pedometers to measure their steps per day. All physical activities in the current study were performed in the classroom with no equipment. The children averaged close to 1200 steps per day which is approximately the equivalent to 30 minutes of physical education (Reed et al., 2010). The fact the movement was performed in the classroom setting, exhibits that you can incorporate physical activity in a limited space. However 95% of school administrators report students have regular access to the gymnasium during school hours (Currie et al., 2012).

In order to achieve the HPE and DPA goals administrative support is required and 65% of teachers state that administers "rarely" or "never" conduct follow-up on DPA or physical activity programs (Patton, 2012). This leads again to the lack of evaluation and need for a committee to oversee the application of health and physical activity programs and policies. Funding is an obstacle when it comes to providing some HPE and DPA programs and less than 1% of total healthcare spending in Canada is devoted to health promotion, physical activity/education and sport (Jones, 2012). However, many activities can be done without equipment or with minimal equipment.

Canada is lacking in the area of "high-level political commitment, integration of physical activity in the national policies, and the identification of national goals and objectives" (AHKC, 2012, p. 67). Elementary schools and teachers need more support by boards of education, public health units, and other stakeholders to maximise the potential

to ensure Ontario schools are the healthier places to learn (Ontario Ministry of Education, 2004). A collaborative effort is essential in making our community a healthier place. Recommendations can be attributed to many divisions; governments need to establish provincial multi-sector plans, policies and programs to address the need of increasing physical activity; health system require updates to guidelines, educate society and develop tools to aid in establishing a healthy body; workplace establishing a corporate culture that influences positive lifestyles, such as health days, strategies to be active at work, and in-house programs and policies; schools/school boards to provide quality DPA and education ensure the teachers are trained in physical education and provide opportunities for the students to be active during recess and after school (intramurals); and the home environment that promote physical activity by sending children outside to play, be a role model and get involved in community activities.

A framework that is needed to be instilled in order to accomplish our goals to attain and develop active, healthy individuals consists of (a) promote a broad vision of heath, (b) develop healthy public policy, (c) build capacity, and (d) measure and report progress (AHKC, 2012). All aspects of this framework are essential in the development and sustainability of the policies and programs in place. Ideally all children should be able to reap the benefits of PE specialist's knowledge, passion and mentoring for a healthier school community that embraces and celebrates PE and DPA (Patton, 2012).

Integrating Activity Into Other Areas of the Curriculum

To recap, overweight and obesity rates among Canadian youth have increased over the last 30 years (Shields, 2005; Tremblay, Katzmarzyk, & Willms, 2002, as cited in Robertson-Wilson & Levesque, 2009) and over one quarter of Canadian youth can be

classified as overweight or obese (Shields, 2005). Physical activity promotes skeletal health, academic outcomes, and anxiety reduction (Strong et al., 2005).

Despite these benefits many people do not attain enough physical activity daily to achieve such benefits. A multivariate analysis of kindergarten and first-grade children showed a negative association between obesity and academic achievement (Datar, Sturm, & Magnabosco, 2004, as cited in Trudeau & Shepard, 2008). Therefore if we make time for PA, it will benefit our students academically as well as socially and emotionally. In order to protect our future generations from diseases and other implications, it is vital to educate our children and youth and establish physical activity routines in which they can take into adulthood.

The most common factor, as stated above, of integrating DPA and increasing HPE time is that educators do not have enough time. The handbook is the solution to this problem, due to the fact that the handbook contains physical activities that directly relate to other subjects in the Ontario curriculum and therefore can be part of your lessons and not in addition to. Games and exercises that require problem-solving are associated with improvements in perceptual skills, IQ, academic achievement, verbal tests, mathematics tests and developmental level (AHKC, 2012). PA also increases self-esteem and appear less likely to develop mental health problems (Biddle, 2011).

The handbook is targeting grade 4 because this is where the largest decrease in physical activity lies, from 6-10 year olds to 11-14 year olds, both females and males (Tremblay et al., 2010). Some practical recommendations include incorporating innovated practices such as, active transportation between classes (crab walk, lunges, representing an animal, etc.), replacing screen based sedentary behaviours with

kinesthetic games (Wii©, X-Box Kinect©, etc.) or with physical movements that mimic what you would be doing on the computer.

Unfortunately, the levels of overweight youth continue to increase at a striking pace; however by providing an increased priority on quality DPA and physical activities throughout the day in the classroom is a step in making our future generation healthy and happy. The benefits of physical activity will be further explored in the upcoming sections.

Academic Benefits of Physical Movement

Now that we have established that the brain and body are connected on numerous anatomical and physiological levels, the effects of physical activity (PA) on the brain in academic achievement will be communicated and strongly supported through research evidence. If there was one thing that could make us smarter, would we do it? Of course we would! Well good news, there is one simple thing that can enhance and improve your academic learning and that is physical activity. This section examines how the brain learns, mechanics of learning, academic levels affected by physical activity, and theory of learning that supports physical activity.

Patterns of thinking and movement automatically get stored in basal ganglia, cerebellum and brain stem, areas that scientist once thought were only related to movement (Ratey, 2008, p. 42). The vestibular nuclei are closely modulated by the cerebellum and are critical to the attention system and help our balance, coordination, and most importantly in this case, it aids in turning thoughts into actions (Jensen, 2005). Now we know that cognitive functioning and movement influence and directly affect each other (Endo et al., 2013). As stated in the previous section information travels to from the

cerebellum, the brain's center of motor control, and other parts of the brain involved in learning (Jensen, 2005). In addition, the prefrontal cortex organizing both mental and physical activity and when learning something it is activated. Researchers have used imagining (fMRI) showing that when learning something new the prefrontal cortex it lights up, means the circuit/association is being established by the firing glutamate (Ratey, 2008). Then, once the item is learned and prefrontal cortex goes dark on the imagining screen (Ratey, 2008). This is amazing; the part of the brain that processes movement is the same part that processes learning, as proven through functional magnetic resonance imaging (fMRI). Therefore when we exercise we are firing the same network connections in our brains as when we are learning, the more we exercise the stronger these connections become.

Movement can be effective cognitive strategy and improve learning by (a) strengthen learning; (b) improve memory and retrieval; (c) enhance and optimize a learner's attention, alertness, motivation and morale; (d) prepares and encourages nerve cells to bind to one another-basis for logging new info; and (e) spurs the development of new nerve cells from stem cells in the hippocampus (Jensen, 2005; Ratey, 2008)

Cognition is a broad term that covers many areas of mental functioning including; thought processing, memory, attention, concentration, and creativity (Rasmussen & Laumann, 2013). Therefore when we were are looking and exploring the significant positive connections between physical activity and cognition (Sibley & Etnier, 2003) studies will be addressing a wide range of the areas related to cognition.

Benefits of physical activity on learning have been established and demonstrated at all ages (Rasmussen & Laumann, 2013). The relationship between movement and the

visual system (Shulman et al., 1997), movement and the language systems (Kim, Ugirbil, & Strick, 1994), movement and memory (Desmond, Gabrielli, Wagner, Ginier, & Glover, 1997), and movement and attention (Courchesne & Allen, 1997) have been well established and reinforced over the years (Jensen, 2005).

Starting off, with the simple physiological process that supports the link between movement/physical activities and learning, which is oxygen. Oxygen is essential for brain function, and enhanced blood flow increases the amount of oxygen transported to the brain. Physical activity is a reliable way to increase blood flow, and hence oxygen, to the brain. This increased oxygen to the brain aids in bringing more nutrients, hormones and other molecules needs for optimal brain function. You are essentially feeding your brain (Jensen, 2005).

When we say "learn" it means neurons in our brain are making numerous new connections between each other, over time forming new structures (Gill, 2012). Evidence from studies and imaging show that moderate physical activities increases cognitive processing and number of brain cells (Jensen, 2005). Physical activity also improves the ability of nerve cells to connect (Kotz, 2010), improve areas of the brain associated with attention (Jensen, 2005, as cited in Gill, 2012) and increases cerebral circulation. Improvements to our brain function from physical activity can be contributed to the increase circulation, which enhances a person's focus attention, level of arousal, concentration of NTs, spatial learning, LTP, memory, and reduces the time sitting—which produces blood pooling that is dangerous for your health (Fede 2012; Trudeau & Shepard, 2009).

As stated previous, BDNF improves brain areas vital to learning, when we participate in physical activity it triggers the release of BDNF, brain-derived neurotrophic factor (Kesslak, So, Choi, Cotman, & Gomez-Pinilla, 1998), which enhances cognition by boosting the neurons' ability to communicate with one another (Jensen, 2005). Physical activity has been shown to compensate for the negative effects and decreases in BDNF with a poor, high fat diet (Molteni et al., 2004). Data in the past has revealed people that are more physically active have more cortical mass than inactive people (Anderson, Eckburg, & Relucio, 2002, as cited in Jensen, 2005), the more cortical mass you have the more neuron connections there are. Ratey (2008) states that new research indicates that exercise can affect basal ganglia and corpus callosum, sharpening memory and increase capacity to master new info. Furthermore, regular physical activity has been found to promote structural changes in the hippocampus region of the brain, which is an important area for memory and found to increase neurons, dendrites and synapses essential structural elements located throughout the nervous systems (Reed et al., 2010).

Now to move to the research pertaining to academic achievement that was observed and obtaining in the classroom or academic setting. The correlations among academic performance and exercise have been established since the 1930s (Shephard, 1997, as cited in Rasmussen, & Laumann, 2013). Many short-term and long-term experiments in researching exercises' effect on academic performance consist of measuring the academic achievement through grades after a test.

Hillman et al. (2009) conducted a short-term study on how a single session of exercise (20 minutes walking on a treadmill) affected children's academic achievement. The children performed significantly better in the academic assessment compared to the

resting group (Hillman et al., 2009). Longitudinal studies on exercise and academic performance date back to 1950 in France, where students schedules were altered, regular classes were decreased by 26% and were required to take part in physical activities daily (Hervet, 1952). Students were described as more attentive, calmer, the numbers of sick days were reduced and academics remained consistent, even with the decrease time in class. Fede (2012) similarly concluded that physical activity has a positive effect on cognition, attendance and behaviour.

In the mid-1970s a similar study was conducted, where students received more physical education (PE) and less time on academic subjects. The results found that students who received more PE had significantly higher grades, especially in math, than students who did not receive more PE (Shephard, 1997, as cited in Rasmussen & Laumann, 2013).Physical activity enhanced results for attention, reaction, and concentration assessments (Budde et al., 2008; Caterino & Polak, 1999; Ellemberg & St.-Louis-Deschenes, 2010). When the student physically performs an activity there is an increase of 40% in retention after 2 weeks (Medina, 2009, as cited in Van, 2012). If we can improve student's attention and concentration, then most likely they will be more apt to succeed in learning concepts in the classroom. The more attentive the students are the less likely unwanted behaviours and detractions will arise during the lesson (Linsin, 2009).

Physical activity has been shown to be the greatest single factor in obtaining the optimal conditions for learning (Kotz, 2010; Weiss, 2001). The body is a simple and efficient tool for students to learn and remember concepts (Kuczala, 2010). Using movement or physical activity in learning is referred to as experiential learning, which comes from Kolb's (1984) Experiential Learning Theory, which defines experiential

learning as “the process whereby knowledge is created through the transformation of experience” (p. 41). Kolb explains that knowledge results from the combination of grasping and transforming experiences, which include learning by observing, reflecting, and doing.

This type of learning is a process that is based on participants’ experiences, and through this the learner can construct meaning in a way that is ideal for themselves (Oxendine, Robinson, & Willson, 2004, as cited in Van, 2012). Movement in learning stimulates more of the senses, which Medina (2009) states is the better way students learn and increases their problem solving abilities. Lengel and Kuczala (2010) furthers this statement by addressing the importance of knowing the difference between implicit and explicit learning for improved cognition. “Implicit learning often occurs through movement, life experiences and emotions, and is the preferred way for the brain to acquire information” (Fede, 2012, p. 17).

Another theorist that supports and in which Kolb’s was developed from was Edgar Dale’s (1969) Cone of Experience. Dale theorized that learners retain more information by what they “do” as opposed to what is “heard,” “read,” or “observed.” His research led to the development of the Cone of Experience. Today, this term, “learning by doing” has become known as “experiential learning” or “action learning” (Anderson, n.d., p. 1). This theory will be furthered explored in the section on teaching methods.

Movement differentiates instruction, increases retention, motivation, attention and engagement in the learning process (Lengel & Kuczala, 2010; Ratey, 2008, as cited in Fede, 2012). One of the biggest concerns for increasing physical activity in the classroom

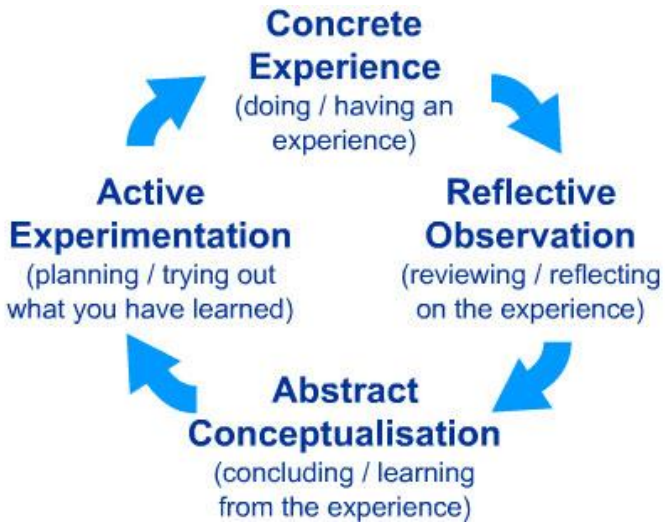

Figure 4. Kolb's Experiential Cycle, 1984. Adapted from McLeod (2013).

and in the school day is the potential loss in time allocated to academic subjects, and the fear that this decrease in time will negatively affect the students' academic grades.

However, Berg (2010) concludes that daily physical education "appears to increase rate of learning and is positively related to academic achievement and that allocating time to PE does not detract from academic achievement" (p. 26). This is furthered by research shown that literacy and numeracy results were unaffected by spending more time of PE (Dollman, Boshoff, & Dodd, 2006).

Research found that exercise or physical activity improves classroom behavior and academic performance (Dwyer, Sallis, Blizzard, & Dean, 2001) and that even when an experimental group got four times more exercise per week than a control group of their peers (375 minutes versus 90 minutes), their "loss" in studying time did not translate into lower academic scores (Dwyer, Blizzard, & Dean, 1996). Other research (Donevan & Andrew, 1986) has found that students who are engaged in daily physical education programs consistently show not just superior motor fitness, but better academic performance and a better attitude toward school than their students who do not participate in daily PE.

Another aspect that is within the broad term of cognition is creativity. Hinkle, Tuckman, and Sampson (1993) found that following physical activity students' creativity was increased. Creativity was assessed through the Torrance Test of Creative Thinking (1962). Increasing creativity allows student to discover and express themselves more effectively, which could also attribute to the optimal learning state that is established through experiential learning.

Despite all the implications and fears of increasing physical activity in the school day, a meta-analysis found an average effect size of .32 significantly greater than zero for enhanced cognition (Sibley & Etnier, 2003). There are two main assumptions when exploring the research: (a) They are generalizing that various forms of physical activity provide similar results, and (b) that all the students or participants received comparable instruction (Trudeau & Shephard, 2010). In my opinion I argue that a variety of physical activity would elicit similar results because when you move, your blood starts pumping regardless if you are jumping, jogging or performing static movements. However for the second assumption I agree that you cannot control for how the participants receive instruction, unless it is the same instructor, which in most cases is impossible due to the number of participants and to the diverse needs of those participants.

Overall, increasing physical activity improves students' academic achievement through improved or maintained grades (regardless of less time spend on academic subjects), enhanced capacity for learning through increased and stronger neuron connections, improved memory, retrieval, attentions, motivation, creativity, decreased sick/absent days and overall improved classroom behaviour and attitude (Ahamed et al., 2007, as cited in Rasmussen & Laumann, 2013; Berg, 2010; Hinkle et al., 1993; Lengel & Kuczala, 2010; Ratey, 2008, as cited in Fede, 2012; Sallis et al., 1999). Consequently, "not implementing a solid PA program you are shortchanging your student's brain and their potential for academic achievement" (Jensen, 2005, p. 67)

Emotional, Social, and Physical Benefits of Physical Activity

Physical activity effects on the human body and mind has been extensively researched and has shown, over and over again, to positively affect emotional, social and

physical wellbeing (Kantomaa, Tammelin, Ebeling, & Taanila, 2008; Kuhnhausen et al., 2013). Stress, anxiety, and depression are major barriers in establishing a healthy mind-set and results can be detrimental in social, physical and mental abilities (Rasmussen & Laumann, 2013). In classrooms it is important to establish a healthy mind set through moderate and vigorous activity, single or multiple bouts, because they are shown to improve psychological well-being and are linked to improvements in cognitive performance (Barton & Petty, 2010; Cox, Thomas, Hinton, & Donahue, 2006; Daley & Welch, 2004; Hansen, Stevens, & Coast, 2001, as cited in Hogan, Mata, & Carstensen, 2013). This section will address how physical activity can benefit individual's emotional, social and physical health. In addition, will address the physiological, theoretical and practical aspects of how physical activity influences a human's complete health.

Emotional Benefits

Emotions are extremely powerful and can alter our health status; they also drive attention, create meaning, have their own memory pathways (LeDoux, 1994), regulate behaviour and essentially aid in uniting the world around us (Damasio, 1994, as cited in Jensen, 2005). The connection of the mind and body starts with the nerve cells that connect cerebellum to prefrontal cortex, the motor center, which controls emotional and social skills (Ratey, 2008).

Physical activity increases blood flow, leading to the brain retrieving and producing dopamine, serotonin, and norepinephrine (Ratey, 2008; Weiss, 2001, as cited in Gill, 2012). This increase in neurotransmitters levels provide individuals with a feeling of pleasure and happiness. Biologically, depression and feelings of sadness, stress, low self-esteem and other mood disorders are causes by a lack of or low levels of serotonin

and/or dopamine (Dayan & Huys, 2008). These chemicals enhance long-term memory when increased before or after a lesson or concept is taught (Jensen, 2005).

In addition to these pleasure hormones, physical activity enhances brain aminergic synaptic transmission (Paluska & Schewenk, 2000, as cited in Motta et al., 2012). This enhanced transmission leads to an increased level of arousal and attention, resulting in possible lowered anxiety. These statements were discovered based on the endorphin hypothesis, "that suggests beta-endorphins are produced throughout the body during exercise, decreasing pain and creating a euphoric state" (Motta et al., 2012, p. 230). Smith (2013) furthers this connection by stating that the physiological and neural systems that manage emotional responsiveness overlap with the systems that manage muscular activation and motor behaviour. When we move and being physically active the neuro-endocrine response to our brain positively affects our mood and emotions, therefore the more often we can move the better it is for our emotional state and development. Activity and mood interaction was proven constant across Williamson, Dewey, and Steinberg's (2001) study of 9-10 year old students. The exercise group had reduced negative moods and the video watching group had increased negative moods, therefore our physiological and hormonal response to physical activity influences our emotions and mental health to feel pleasure and happiness can aid in supporting and dealing with stress and depression.

Lang and Bradley (as cited in Smith, 2013) define emotions as "action dispositions" (p. 372). Our moods affect our behaviour along with physiology; therefore our aim is to create a positive mood. Technology studies have explored the benefits of "exergames," games that include physical activity (DiTore, D'Elia, Aiello, Carlomagna,

& Sibilio, 2012). These studies found that when physical activity is involved in a game the player's degree of involvement, fun and motivation increases (DiTore et al., 2012). These games can also be referred to as kinesthetic video games that require physical body movement, beyond moving a controller whereas non-kinesthetic video games require only movement of a controller or joystick (DiTore et al., 2012). Chee's (2011) theory of the Performance-Play-Dialog model expresses when an activity incorporates the body, individuals get to embody the experience where they can take control and become emotionally engaged. As stated, body movement affects cognitive and emotional processes, including affective and social communication. When body movement is increased the enjoyment and arousal supports social interaction and in turn emotional health through the proprioceptive feedback that plays an important role in engagement of the activity.

Common emotional and mental disorders or states that humans experience at some point in their life, that directly affect a human's well-being are stress, depression and anxiety. The following will address the causes, process, and physical activity as treatments for these emotional states.

Stress

Stress is a general expression for the physical or psychological challenge to normal homeostasis that is a result of environmental demands or events are interpreted and appraised by the individual as taxing or exceeding his or her resources and endangering well-being (Vanaelst, De Vriendt, Huybrechts, Rinaldi, & De Henauw, 2012; Vreugdenhil, De Kloete, Schaaf, & Datson, 2001). In general there are three approaches for stress assessment (a) the environmental approach, (b) the psychological

approach, and (c) the biological approach. This leads into the how do researchers measure stress on these levels or based on these approaches. Commonly used methods are questionnaires, interviews and checklists, such as Stressful Life Events Scale (SLES) (Vanaelst et al., 2012). At the biological level stress induced some changes in the body that can be measured, such as the production on stress hormones including adrenalin, noradrenalin and cortisol (Vanaelst et al., 2012).

The stress hormone, cortisol, can sure as a biomarker when measuring stress levels. When stress is present cortisol is released by the adrenal cortex into the circulation through stimulation of the hypothalamus-pituitary adrenal (HPA) axis and increases your energy to deal with the stressful situation (Vanaelst et al., 2012). Cortisol does many different jobs during stress, such as it directs metabolism, and restocks materials to replenish energy (Ratey, 2008). Cortisol exhibits a strong rhythm through which homeostasis and metabolic functions are maintained. Cortisol can be measures in blood, urine, saliva, and hair (Vanaelst et al., 2012).

As chronic stress, "HPA axis guzzling all fuel the thinking parts of the brain are being robbed of energy" (Ratey, 2008, pp. 65-66), which increases the vulnerability of neurons and impairments in brain function and cognition (Adlard & Cotman, 2004). This can be attributed to the death of neurons in hippocampus when cortisol is chronically high.

Ripple effect of body's stress response leads to mental disorders, anxiety and depression, and physiological issues of increased blood pressure, heart problems and cancer (Ratey, 2008, p. 59) as it tears at the architecture of the brain. Exercise controls emotional and physical feelings of stress and works at a cellular level. Neurons get

broken down and build up like muscles and stressing them out makes them more resilient (Ratey, 2008). However it is when the balance of stressing the neurons out and resting them is disturbed that problems arise, as mentioned with chronic stress.

Numerous studies have explored the relationship between physical activity and stress in adults, however only a few have looked at children and adolescents. Consequently, Vanaelst et al. (2012) state that childhood stress effects physical and psychological well-being has been extensively studied over the years. Children and adolescents are exposed to a variety of different stressors in their family life, school, health, and multimedia. In both adult and children studies physical activity significantly lowered stress levels resulting in healthier individuals (Ratey, 2008; Middleton, Barnes, Lui, & Yaffe, 2010; Vanaelst et al., 2012).

Anxiety

Anxiety is the emotion of fear (Ratey, 2008) and is defined as "feelings of uneasiness, apprehension, distress, and worry about the future, with or without an identifiable cause" (Schomer & Drake, 2001, as cited in Motta et al., 2012, p. 229). The anxiety hypothesis as to how physical activity lowers anxiety can be contributed to the distraction hypothesis, where physical activity distracts ones from unpleasant stimuli and worries, along with the self-efficacy theory (Bandura, 1977) whereas physical activity provides a person with confidence and increased view of their capabilities.

In accordance to these theories physical activity lower anxiety because it lowers resting tension of muscles, and when the body is calm the brain is less prone to worry (Ratey, 2008). The chemicals in the brain are affected as the increase in BDNF that comes with physical activity increases the level of serotonin, which calms us down.

Moving the body triggers release of GABA, brains major inhibitory NT and having a normal level is essential in ceasing anxiety (Ratey, 2008). Basically exercise stops the obsessive feedback loop within the brain. Physical activity also secretes ANP which attached to receptors in the hypothalamus to regulate HPA axis activity (Ratey, 2008). ANP has been shown to have a calming effect and researchers believe this may be the major link between exercise and anxiety (Ratey, 2008). Strohle, Feller, Strasburger, Heinz, and Dimeo's (2006) and Strohle et al.'s (2007) studies found and reproduced that ANP significantly increased after walking for thirty minutes on a treadmill, which lowered the feeling of anxiety and panic. This concludes that the physical activity does not have to be extremely vigorous in order to achieve the benefits.

Smith (2013) found that after only a 15 minute bout of exercise, the state of anxiety was decreased and remained significantly decreased after the exercise bout compared to the seated group, who's level went back up to baseline. Aerobic exercise was also found to work immediately to fend off the state of anxiety (Ratey, 2008). These single session improvements in mood and reduction in subjective symptoms of anxiety found in healthy non anxious adults has been well established (Smith, 2013). Carl Lavie and Richard Milanu (2004) expressed that exercise has been shown to lead to a decrease of more than 50% in prevalence of anxiety symptoms.

Similarly Annesi (2005) conducted a controlled study with grade 4-6 students who exercised for 15 minutes or rested/did busy work for 15 minutes and recorded their anxiety state before, immediately after and 10 minutes after the treatment. The results showed a significant reduction in anxiety associated with students who exercised compared to the quiet rest group (as cited in Motta et al., 2012). Studies have proven that

regular exercise in adolescents reduced the levels of anxiety and inactivity puts higher risk for depressive and anxious mood in adolescents (Birkeland, Torsheim, & Wold, 2009; Jerstad, Boutelle, Ness, & Stice, 2010; Molteni, Vaynman, Ying, Barnard, & Gómez-Pinilla, 2004; Monshouwer, Ten Have, Van Poppel, Kemper, & Vollebergh, 2009; Rothon et al., 2010; Wiles, Haase, Lawlor, Ness, & Lewis, 2012) supporting the notion that children who have higher anxiety are more likely to develop depression in their life later on (Motta et al., 2012; Ratey, 2008).

Exercise can be used as a treatment for anxiety because it works on the brain and body by: providing distraction; reduces muscle tension; builds brain resources (serotonin, norepinephrine, GABA, and BDNF); teaches a different outcome (symptoms that are the same in exercise and anxiety, such as increased heart rate, are associated with positive outcomes); reroutes your circuits (activate sympathetic nervous system through exercise means that your brain breaks free from the passively waiting and worrying it is trapped in); improves resilience (self-mastery); and sets you free (taking action, exploring, and moving) (Ratey, 2008, pp. 106-108). All these benefits for simply moving your body on a regular basis, try it and you will feel the benefits immediately.

Depression

Depression is a serious condition where individuals experience prolonged sadness that reduces their interest in normal daily activities and impair everyday functioning. Depression increases the risk of physical and mental illness, along with personal difficulties (Motta et al., 2012). As many as 2 out of 100 young children and 8 out of 100 teens have serious depression (Wagner & Brent, 2009). Problems with depressed children

and adolescents are that the depression can extend into adulthood where more dangerous behaviour can arise.

Depression is the erosion of connection, both between the brain cells and in life, essentially affecting all aspects of a life (Ratey, 2008). Exercise re-establishes these connections (Ratey, 2008). Exercise releases endorphins (stress hormones) that decrease pain and increase joyful feelings, this is referred to as a "runner's high" (Ratey, 2008, p. 121). When you exercise the endorphins increase and regulates all neurotransmitters targeted by antidepressant medications. The increase in norepinephrine affects self-esteem, dopamine increased mood and feelings of wellness and serotonin which positively affects mood impulse control and self-esteem (Ratey, 2008). Now if you continue to be physically activity the dopamine storage in the brain increases which means there's more room for increased mood and feeling of wellness. Exercise therefore makes you feel good.

Brain scanning through position-emission tomography (PET) and fMRIs allowed scientists to see how depression works and what part of the brain it affects. At the same time, researchers discovered new cells are born every day in the hippocampus and prefrontal cortex. Through imaging we know that these two areas of the brain are shrivelled in depression (Ratey, 2008). BDNF is affected negatively by depression and exercise increases BDNF as much as medications due (Ratey, 2008).

Motta et al. (2012) reviewed the role of exercise in childhood posttraumatic stress disorder (PTSD), anxiety and depression. PTSD is stressors or events that are considered outside normal human experience (Motta et al., 2012). Exercise has been found to reduce anxiety and depression symptoms associated with PTSD, this can be proposed by the

facts that exercise increases endorphin levels providing perceptions of mastery, improved health appearance, distraction from worries also known as “stress buffering” (Tucker, Cole, & Friedman, 1986, as cited in Motta et al., 2012, p. 226) and other positive emotional changes. A variety of different physical activities and at a variety of intensities have shown a significant reduction in PTSD, anxiety and depression after the session(s) and remained low at the one month follow-up (Diaz & Motta, 2008; Newman & Motta, 2007). Crews, Lochbaum, and Lander’s (2004) study had grade 4 student participants, who were assigned to the aerobic exercise or control group. Depression scores were obtained at the end of the study and the aerobic group had significantly lower depression than the control group (Motta et al., 2012). It is crucial to note that these students were not diagnosed with any anxiety based, emotional or mental disorders, therefore exercise can benefit everyone’s mood and mental health.

There are different treatments for depression which include medication and therapy. Medications work from the brainstem up to the prefrontal cortex, whereas therapy works from the prefrontal cortex down. Physical activity trumps both of these treatments in the fact that it attacks from both ends (the brainstem and the prefrontal cortex) at the same time, plus adjusts all chemicals (BDNF, IGF-1, VEGF, and FGF-2) that provide building materials and oversee construction of neurons and new connection, and increases neurotransmitters to restore normal cell signaling (Ratey, 2008). When your prefrontal cortex is fired up, like in physical activity, you remember good things, which most likely will place you in a positive mood resulting in improved health.

Social Benefits of Incorporating Physical Movement Into the Learning Process

Dourish (2001) uses the term "embodied interaction," which I think is ideal when describing physical activity benefits on social well-being. Physical activity can lift one's mood (Kuhnhausen et al., 2013). Positive mood facilitates social interaction (Haviland-Jones, Rosario, Wilson, & McGuire, 2005). Some key aspects of social well-being that physical activity positively targets are self-esteem, self-efficacy and self-imagine.

Self-esteem is the discrepancy in how a person evaluates themselves (self-image) and how they wish they were (Sinrgy, 1982, as cited in Rasmussen & Laumann, 2012). Self-esteem can also be defined as "a person's positive or negative attitude towards the self in totality" (Bagley, 2001, as cited in Reed et al., 2013, p. 1). Self-esteem is one aspect of mental health and methods to improve self-esteem are important in total well-being.

Physical activity and exercise effects on an individuals' self-esteem was briefly discussed above regarding the endorphins released during exercise, these endorphins provide an individual with a sense of mastery, and increased beliefs in their capabilities and confidence. Physical activity increases arousal through the increase of neural activity, this increase is likely to enhance attention, facilitate learning and has a calming effect (Trudeau & Shephard, 2010).

There have been several studies that support the positive relationship established between exercise and mental health changes in children's self-esteem (Deslandes et al., 2009; Ekeland, Heian, Hagen, Abbott, & Nordheim, 2004; Rees & Sabia, 2010; Weiss, 2001) and in self-efficacy—a sense of personal control over life's daily challenges (Weiss, 2001). A study of grade 6 children in New Brunswick, Canada and a study in

Hong-Kong found a positive relationship between level of activity and self-esteem (Trudeau & Shephard, 2010). A cross-sectional study by Kirkcaldy, Shephard, and Siefen (2002) found that regular physical activity was connected to improved self-image and psychological well-being compared to the less active group. In 2007, Schmalz et al. furthered the positive connection between physical activity and self-esteem (as cited in Rasmussen & Laumann, 2012). Activities of all intensities have had positive effects on an individuals' self-esteem (Reed et al., 2013). Reed et al. (2013) conducted a study on elementary students who were exposed to a regular exercise or exercise in nature "green exercise" and there effects on self-esteem. It was concluded that both types of exercise had a significant effect on self-esteem, however one did not significantly improve self-esteem over the other.

Healthy self-esteem supports positive social activity and psychological development, consequently when self-esteem is damaged it places the student at risk of psychological problems and hinders recovery of low self-esteem (Hosogi et al., 2012). A resource that educators can use is from the World Health Organization called "Preventing Suicide: A Resource for Teachers and Other School Staff" (2000), which states that "positive self-esteem protects children and adolescents from mental distress and despondency, and enables them to cope adequately with difficult and stressful life situations" (as cited in Hosogi et al., 2012, p. 1). Kokenes (1974) conducted a study that resulted in between grade 4- 8 that grade 6 students had the lowest self-esteem. When educating students we must take into consideration their age, their mood, mental and physical development and sources that could affect their self-esteem. The child's self-esteem is mainly influenced by their environment (Hosogi et al., 2012); therefore it is

essential that in the classroom and school setting, educators provide opportunities to improve students' self-esteem.

It has been proven; games that require physical effort have a strong effect on creating social bonds (Mueller, Agamanolis, & Picard, 2003, as cited in Bianchi-Berthouze, 2013). Adapting your body as a controller enhances the degree of social interaction and collaboration increases (Bianchi-Berthouze, 2013). Considering kinesthetic video games, they tend to offer a more interactive and "open communication between player and game which allows continual trial and error" (Mellecker, Witherspoon, & Watterson, 2013, p. 352). This freedom to take risks and make mistakes can significantly aid in development. Exergames provide movement that allows students to experience pleasure, which leads to deep engagement (DeCastell, 2011), strong motivation and can increase self-consciousness skills' development (DiTore et al., 2012).

Berk (2007) agrees that the lower levels of anxiety are related to the endorphins released during exercise and that the improvements in mood correlate with improvements in social skills, self-confidence and decreased negative thoughts (as cited in Motta et al., 2012). This can be attributed to the fact that the area of brain active in processing social events often process cognitive events as well (Frith & Frith, 1999, as cited in Jensen, 2005). Physical activity can provide opportunities to increase social skill development, as certain activities include other people's participation. The US National Longitudinal Study of Adolescent Health reported a positive association between physical activity and several components of mental health, including self-esteem, emotive well-being, spirituality, and future expectations (Yu, Chan, Cheng, Sung, & Han, 2006, as cited in Trudeau & Shephard, 2010). Physical activity improvements on academic performance

were discussed and the increase in academic performance can itself result in an increase of self-esteem (Ekeland, Heian, & Hagen, 2005, as cited in Trudeau & Shephard, 2010). Exercise more important for prevention than treatment, therefore the earlier we can implement DPA into children' lives the better off they will be in adulthood, physically, mentally, and socially. Benefits of exercise as a treatment because you can take it into your future with you, it is accessible, self-prescribed, and cost-effective, can essentially be free. Engaging in activities gives us a sense of accomplishment, control, and purpose, resulting in a positive outlook on your life; your brain and body are nourished (Weiss, 2001).

Dwyer et al.'s (2001) research further supports that social skills improve in groups who exercise more through the enhanced ability to handle stress by "training" the body to recover faster from the quick surges of adrenaline associated with demanding physical activity and classroom environments, enhance social skills, emotional intelligence, and conflict resolution ability. In addition, physical activity increases neurotransmitters (brain chemicals such as norepinephrine and dopamine), which typically serve to energize and elevate mood (Chaouloff, 1989, as cited in Jensen, 2005).

These positive relationships between exercise and mental health are widely evidenced, specifically in changing a child's self-esteem (Reed et al., 2013). Healthy self-esteem supports positive psychological and social activity and is essential in children development (Hosogi et al., 2012). Stress, anxiety, and depression are crucial for optimal well-being in all dimensions so move your body and your brain will not choice but to help you feel fabulous.

Physical Benefits of Physical Movement

The physical activity benefits on the muscular and cardiovascular systems have been extensively researched. Improved muscular strength, flexibility, and endurance with physical activity is well known, however this section will address the benefits of physical activity on your immune system and physiological functioning.

Cortisol plays a role in numerous body systems including the immune system. Social stress weakens your immune system (Padgett & Sheridan, 2002), physical activity decreases stress resulting in an improved immune system. Simply stating that exercise combats stress related diseases (Ratey, 2008). As stated above, physical activity improves a person's mood and Salovey, Rothman, Detweiler, and Steward (2000) concluded that your mood affects your immune system and physiological function. Just by talking a walk you can reduce the risk of heart attack, hip fractures, diabetes, and colon cancer and lower your blood pressure (Ratey, 2008). It was even proven that having workplace gyms resulted in fewer sick days and increased production (Ratey, 2008). When we exercise our mood increases resulting in an improved immune system, which means a healthier body and healthier, happier life.

Application for Educators of Movement in the School Day

Emotions and body movements contribute to a better learning experience through the enhanced teaching/learning process by the increased circulation, enhanced episodic memory and the increased brain function (Fede, 2012). As discussed, physical activity affects the neurotransmitters that effect mood and feeling of wellness, when we are physically active dopamine pushes outward toward the front of the brain and concentrates in an area. This state is absolutely essential for learning (Jensen, 2005).

When educating students on the numerous benefits of physical activity it provides them with the knowledge and a coping strategy when dealing with life stressors.

> UNICEF's adoption of the document "A World Fit for Children" (2002) states that children, including adolescents, must be empowered to exercise their right to expression in accordance with their evolving capacity; build self-esteem; and acquire knowledge and skills needed for conflict resolution, decision-making, communication, and endurance of life's challenges. (As cited in Hosogi et al., 2012, p. 1)

We, as educators can provide opportunities for the students to exercise their rights and build positive self-esteem, resulting in respectful and confident individuals.

Children and adolescents spend a majority of their day in the school setting, and we know that their emotions are influenced by their environment then it is inevitable that physical activity needs to be provided in the school day. There are many ways to incorporate physical activity in the classroom, such as taking 10minute walk breaks, remember that benefits are achieved at all intensities, or letting the students out 10 minutes early for recess or even making more time for health and physical education. As little as 10 minutes can be sufficient for a favourable change in mood (Anderson & Brice, 2011). Salovey et al. (2000) state that when humans have a positive emotional state it signals that their environment is safe, which positive moods of students and faculty need to be in place. When a learner is active it allows learners to make mistakes without harmful consequences because of the greater interaction, which leads to less embarrassment and more fun in the school setting, establishing a safe environment (Jensen, 2005; Mellecker et al., 2013). The most effective, efficient, and capable

intervention to increase positive moods in your classroom is to be physically active. As a teacher, you can achieve the benefits of physical activity by going on a walk during part of your break or lunch time, participating in physical activities in your physical education classes, performing daily physical activities provided by the ministry or by simply going for a walk after school.

Having physical activities in the school setting daily will positively affect every student, and the students who are diagnosed with emotional disorders would greatly benefit because they would be less resistant to this treatment than other therapeutic interventions because it is seen as part of their school experience. In order to implement effective exercise and physical activities in the schools there needs to be an emphasis on collaboration between physical activity specialists, physical education teachers, school psychologists, and other professionals.

The structure of increasing physical activity in schools also provides social benefits that could result in positive academic outcomes, due to the reduced stress, altered mood states, increased arousal and attention (Sibley & Etnier, 2003, as cited in Kantomaa et al., 2010; Taras, 2005). "Children who learn to cooperate, share, and abide by rules of group physical activities and those who learn to discover and test their physical abilities even in individual activities are likely to feel more connected to their school and community and want to challenge themselves" (Taras, 2005, p. 214). Physical activities programs help children develop social skills, improve mental health, and reduce risk-taking behaviors, such as attempt suicide, adopt risk-taking behaviours, and become pregnant—all of which may be associated with better academic outcomes (Brown & Blanton, 2002; Patel & Luckstead, 2000, as cited in Taras, 2005).

The school environment is an essential opportunity to provide students and yourself with the benefits of the physical activity. When our mental health and emotions are positive and intact, then our daily functioning, learning and experiences are unquestionably enhanced as a result of the physical activity benefits on multiple aspects of brain function and cognition (Hillman, Erickson, & Kramer, 2008). Our actions will aid in preventing diseases, disorders and making irrational decisions that could affect others. Let's provide ourselves and our students with the lifelong habits of being physically active, providing a healthier mentality, body and overall happiness.

Strategies and Techniques for Incorporating Physical Movement Into the School Day

The main strategy is to create cross-curricular lessons, identify objectives and content desired to be learnt and discuss with specialty teachers (PE) what would be developmentally appropriate and some ideas of what are doing and try to bring the physical activity into the lesson to reinforce the content. This is where my handbook provides manageable activities that have direct curriculum connections. In addition, educators can bring simple, limited space physical games into the classroom, such as the Wii©, MicrosoftKinect©, twister, and other activities that do not require a lot of space. Lastly, becoming an advocate for physical activity you will get the most out of the teaching/learning process, which can be accomplished through collaboration in formulating a plan of action for classrooms, schools, and communities.

There are resources available for educators and schools as well to aid in gathering knowledge about physical activity guidelines; Canada's Physical Activity Guide to Healthy Living: Teacher's Guide to Physical Activity for Children, Public Health Agency

of Canada, Capacity Building Series: Integrating learning in the classroom (September 2010), which aid educators in integrating cross curricular connections into the classroom lessons and the importance of thinking real-world providing opportunities for students to develop their understanding through applications and experiences.

When creating cross curricular lessons that incorporate physical activity some concerns that must be address are space, safety, effort, cost, and resources available. Laban's Movement Framework offers a useful structure for organizing elementary lessons that incorporate physical activities and physical education that considers body, space, effort and relationships. Establishing the foundation for lifelong physical activity by providing quality daily physical education, taught by teachers trained in that area (OMHLTC, 2004). Leaving PE up to the professionals also provides teachers with extra time to prepare and in turn feel more refreshed and not as rushed.

In addition, training needs to be established for teachers to make them aware of the benefits and how to implement DPA into the classroom. Misconceptions about lessons that involve physical activity are that there is not enough space, equipment, and the risks of injury are too high. However physical activities in the classroom do not always need a lot of space and equipment. My handbook provided activities that can be done inside, outside, and with minimal resources. The numerous benefits of physical activities far exceed the risks of implementation; educators just need to be aware of safety hazards when planning the activity. Consequently, as previously stated, when lesson incorporate physical activity the students feel safer and more confident than lecture lessons.

Being able to provide movement activities in the classroom can offer an interesting and engaging strategies that are shown to enhanced students' understanding, memory, attention, mood and overall well-being (Clements, 2006; Tong, Shen, Perreau, Balazs, & Cotman, 2001; Wood, 2008). Physical activity also provides a step by step increase in understanding, knowledge and application of content due to the fact that they personalize their learning and can rehearse and perform trial and error, which decreases stress (De Castell, 2011) until they establish an comprehensive grasp on the content. Kinesthetic activities anchor academic concepts resulting in cognitive reinforcement. As Blaydes (2000) notes, "movement prepares the brain for optimal learning" (p. 2).

Overall, physical activity enriches the learning environment (Fede, 2012), through the production of transferable skills and understanding, which are the main focus in becoming a well-educated individual. Students are more engaged with ideas and learning if an element of movement is involved (Wood, 2008). Placing concepts in context can scaffold learning toward new ideas, giving purpose to the student's learning. The most important ideas is to expose students to the notion that physical activity is fun and to encourage them to take a first step and try something new. So use more standing than sitting, more walking than standing and more organized activities than walking. Do not deprive your students of the optimal learning experience, get moving!

The Ontario Science Curriculum

Science is indefinable in our daily lives and its importance in our lives, as Canadians, is growing (Ontario Ministry of Education, 2007b). Science is the gate-keeper for many university programs (Malekan, 2008), therefore a resource that can aid in

learning and understanding science concepts at an elementary level can greatly benefit students' future.

The past science curriculum had the first overall expectations as understanding basic concepts, which has now moved down to expectation three. This could be rationalized by the updated science curriculum goals placing a larger value of application skills versus basic concepts. Providing opportunities for students to develop their application skills can be achieved through movement, as the students remember and learn more by doing and relating a physical experience to a concept (Fede, 2012; Kolb, 1984; Oxendine et al., 2004).

The new science curriculum has presented substantial challenge and opportunities for teachers (Pedretti & Bellomo, 2014). Wellington (2001) addresses some of the challenges and opportunities that arise with the new science curriculum, the first being the tension "between scientific knowledge for its own sake and science education for its utility" (p. 170); stating that the aim of the science curriculum needs to be on application of science knowledge and not just memorizing or reciting facts. Often the focus in science classrooms has been on teaching disciplinary knowledge, leaving minimal room for open-endedness (Aikenhead, 1994; Pedretti & Bellomo, 2014; Roth & Desautels, 2002). The second substantial challenge and opportunity noted by Wellington (2001) is "between preparing future scientists and teaching science for life," (p. 170) which requires establishing scientific skills that are transferable into other areas of learning and in life. This ability of the science curriculum to develop students' skills that can be transferred to other areas of learning demonstrates the ability to connect the science

lesson to other subjects. In essence the science curriculum provides numerous opportunities for cross-curricular connections.

The updated science, technology, society, and the environment curriculum (STSE) is complex, open-ended and reinforces science as related to values and applications and not just about knowledge (Pedretti & Bellomo, 2014) and has new and expanded the cross curricular & integrated learning for program planning aspect (Lambton Kent District School Board, n.d.). Therefore, the concern that the OSC's expectations are very subjective could be seen as an opportunity to provide an optimal learning experience as it offers many openings for cross curricular connections, such as language for communication, math for problem solving and probability, health and physical education for human impact/environmental issues and many more. This is one of the great aspects of the science curriculum, which your lesson is not just specifically isolated to science but also includes health and physical education, language, math, and others. Furthermore, research backs that science and language arts have beneficial effects for integrating these disciplines with physical activity (Reed et al., 2010).

Most importantly, the science curriculum offers the opportunity to incorporate physical activity. Physical activities, both individual and group, provide opportunities for students to be creative, use imagination and further develop their understanding of the scientific concepts (Pedretti & Bellomo, 2014). Active participation, such as role playing also provides students the chance to be creative enhancing their critical thinking, through group and individual learning (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006).

Science often becomes abstract, linear, and voids any society, cultural, or political context because the knowledge is just being delivered to students (Pedretti & Bellomo,

2014). When teachers focus on the students just being able to understand and recite basic knowledge without being able to apply, critically think or problem solve, Freire (2000) describes this teaching method as the "banking method" (p. 86). As most educators agree that the important part in teaching students is getting students involved. Daryl Siedentop (1991) a famed physical educator from Ohio State University, posits that students learn through their involvement with the content. Integration of subject matter allows for more student involvement in the learning experiences.

Students favoured classes that they got to be active and moving in (Jenkins & Heidorn, 2009). Movement and activities in learning are essential aspects in active or inquiry-based teaching that engages students' minds in problem solving and investigation, in which science teachers have long recognized the importance of (Jenkins & Heidorn, 2009). Research proves that physical movement, particularly coordinated, balanced movement, increases neurotransmitters that stimulate grow of new neurons and connections in the brain (Gill, 2012; Jensen, 2005). Despite the lack of activity in today's society, students have a desire to move and be active. If we can provide opportunities for students to move during the school day, academic performance, personal well-being, and overall health will improve (Jensen, 2005; Mang et al., 2013; Rasmussen & Laumann, 2013). In addition, physical activities will aid in concentration and attention, skills that are crucial when learning content (Budde, Voelcker-Rehage, Pietrassyk-Kendziorra, Ribeiro, & Tidow, 2008; Ellemberg & St.-Louis-Deschenes, 2010; Rasmussen & Laumann, 2013; Taras, 2005). In addition, Blakemore (2003) reported that the brain is activated during physical activity by increasing blood flow to essential areas that stimulate learning. Strong associations between the cerebellum and memory, spatial

perception, language attention, emotion, nonverbal cues and the decision making ability of students have also been found (Blakemore, 2003; Jensen, 2000).

It is possible to incorporate movement into science lessons, which can aid in addressing abstract concepts, such as The Gear Program, that discovered integrating physical activity into the classroom can invigorate students, as well as providing positive effects on student learning (Maeda & Murata, 2004). Physical educators can assist in developing accurate and developmental appropriate activities for the lesson. The purpose of movement activities in lessons is to engage students and reinforce learning. Therefore the activities must have a direct scientific connection.

In conclusion, the new and updated OSCs place a renewed emphasis on environmental education (STES), and safety, along with promote students to take action, get involved and apply their knowledge. At a macro level, science, technology, society, and environment education (STSE) examines the interface between science and the social world, promoting the development of a critical, scientifically and technologically literate citizenry capable of understanding socio-scientific issues, empowered to make informed and responsible decisions and able to act upon those decisions (Aikenhead, 1994; Hodson, 1998; Pedretti, 2003; Pedretti & Bellomo, 2014).

This expands the roles of student and teacher, and places an addition of roles from parents, principals and community partners. The curriculum clearly outlines the strands and topic connections from grade 1 through till grade 12. The updated science curriculums provide sample questions, examples, issues, and prompts, along with providing a skill continuum to document a student's progress throughout the year. These skills that students develop through the science curriculum are transferable skills, in

which they can take with them into other subjects and even aspects of their life. The skills and knowledge are now reported and documented using the assessment and evaluation descriptions and charts provided in the curriculum, which align with the *Growing success: Assessment, evaluation, and reporting in Ontario schools* document (Ontario Ministry of Education, 2008a). Another great aspect of the updated science curriculum is that it provides additional cross-curricular and integrated learning considerations for program planning. STSE offers opportunities for enriching science, which can be done through implementing physical activities into the lessons.

Teaching Method

Now that the benefits of incorporating physical activity into the classroom and school day have been well explained, the methods and theory supporting physical movement in the classroom will be addressed.

Movement in learning was the norm in kindergarten classrooms; however it is quickly dissipating from our educational system (Resnick, 2009). Resnick (2009) states, "In today's kindergartens, children are spending more and more time filling out worksheets and drilling on flash cards" (p. 1). In a nutshell, kindergarten is becoming more like the rest of the school. The new Ontario curriculum for kindergarten (Full-Day Early Learning Kindergarten Program (ELKP)) released in 2010/11 aims to combat this as the purpose of the program is "to establish a strong foundation for learning in the early years, and to do so in a safe and caring play-based environment that promotes the physical, social, emotional, and cognitive development of all children" (Ontario Ministry of Education, 2010/11, p. 1). However in grade one, students are no longer able to express themselves through physical activity in the classroom, instead they are told to

copy and paste materials from the board and complete numerous worksheets (Van, 2012). It seems this reciting and lecture style learning continues right up into postsecondary education.

From previous experience and research, during lessons students who are expected to sit and copy information bores them and can create behavioural issues in the classroom. In addition, during passive lessons, there is always at least one student up and moving, either going to sharping their pencil, throw something in the garbage, basically anything to get up and move for a break. This can be referred to as over teaching, which provides less opportunity for self and group discovery skills.

Classroom and school provide opportunities for endless emotional, personal, social and physical development (Jensen, 2005). Consequently, education is linked with physical activity, emotions, culture and environment (OMHLTC, 2004). Students decided whether their surroundings feel safe, friendly and/or familiar. Allowing students in the classroom to position and move to aid in learning, they feel less restricted and enhance their learning (Jenkins & Heidorn, 2009), which requires providing areas to foster physical movement. Adding movement to the classroom setting can also create positive emotions of interest, comfort, suspense and enjoyment (Van, 2012). This is attributed to the fact that the mind and emotions are linked. The body releases dopamine and norepinephrine during movement and fun movement activities, as previously explained, and these chemicals enhance long-term memory when administered before, during or after learning (Jensen, 2005). The social and emotional factors to motivation include that the activity must pose a challenge and are fun (Bianchi-Berthouze, 2013). The engagement factor consists of body movement, and role playing experiences that

facilitate social engagement. Physical activity provides a high degree of involvement and fun which is a strong motivation for students (Jenkins & Heidorn, 2009).

When providing physical activities in the classroom a social aspect is involved. When students are physically active working cooperatively can enhance learning, promote interaction, aid in development of interpersonal skills and meta-processing skills (Jensen, 2005). "Quick, active play enhanced the ability to handle unexpected events and regulates stress; fosters quick planning, decision making, and evaluative judgement; boosts creativity; forges social bonds; and introduces emotional intelligence and codes of conduct" (Jensen, 2005, p. 97).

Kuczala (2010) outlines six purposes for incorporating movement into the classroom:

1. Preparing the brain: the brain's movement and cognition growth needs to grow and can achieve this through physical activity that stimulates the appropriate systems.
2. Providing brain breaks that are necessary for emotional wellbeing, refocusing the students and brings fun into the lesson.
3. Supporting exercise and fitness which combats mood disorders (Ratey, 2008), illnesses and diseases.
4. Develops class cohesion and builds relationships, teamwork skills and sense of belonging.
5. Reviewing content using movement allow the students a playful and enjoyable way to review information

6. Teaching new content using movement so that "information can be easily accessed and available for later use because of its implicit nature" (Van, 2012, p. 31).

Duckworth (2006) states that intelligence is often mostly complete and productive at work in play (as cited in DeCastell, 2011). Playfulness enables "risk taking, replay affords second chances and trying again, agency develops control and mastery, embodiment enables multimodal engagement, pleasure supports motivation and inventiveness, attention mobilized intelligence, serious play and hard fun make for deeper learning" (DeCastell, 2011, p. 26).

Technology increases knowledge and cognitive performance, more focused, motor skill development, multiple sensory systems to solve a problem or perform a task and produce a higher level of thinking than sedentary forms of video game technology (Mellecker et al., 2013). Schools have used "exergames," as explained in previous sub-chapters, which facilitate and support the learning processes with strong cognitive and emotional involvement through the use of the body and technology (DiTore et al., 2011). These games have been proven to be able to transfer knowledge learnt in the game and apply it to a test (Mellecker et al., 2013). In addition, exergames has a calming effect on students with hyperactivity, no reports of difficulties with implantation or with class control when using the physically active video game, and a high level of interest and enjoyment in the game and learning (DiTore et al., 2011; Mellecker et al., 2013). The possible issues with technology based physical activities are the cost and portability of the system and may be the reasons why educators do not use these physical activity opportunities.

The increase in testing also can be attributed to the lack of physical activity in the classroom, as the emphasis is one increasing math and language scores. However, increasing the time allotted for physical activity has shown to improve academic (Berg, 2010), so why have schools not taken upon this proven method of incorporating physical activity, to improve academic performance (Kotz, 2010, as cited in Gill, 2012)?

Summary

Physical activity stimulates the brain for optimal growth and learning. Research shows that PA builds strong bones and strengthens muscles (including the heart), maintains flexibly, promotes good posture and balance, improves fitness, self-esteem, increases relaxation, enhances healthy growth and development and helps children make new friends, thus addressing their social well-being (Public Health Agency of Canada, 2002).

It is clear to see that lecture style learning, teaching to the test and eliminating PE/PA from schools is not the answer, as it excludes implicit learning which allows the brain to learn quicker and remember more accurately, this learning often involves movement, life-experiences, and emotions (Lengel & Kuczala, 2010). Physical activity and play is experiential and learning actions are transactional (Dewey, 1938/1988; Elkjaer, 2009, as cited in Chee, 2011), thereby developing transferable skills required for success in various areas of life. NASPE (2011) released a position statement titled *Physical Education is Critical to Educating the Whole Child*, which states: “Research confirms that students perform better in school when they are emotionally and physically healthy. They miss fewer classes, are less likely to engage in risky or antisocial behavior, concentrate more and attain higher test scores” (p. 1).

Educators need to realize that faculty and administrators are on the same side in fighting childhood obesity, reducing the onset of type 2 diabetes, and using exercise to combat behavior disorders, while at the same time increasing cognition. Ratey (2008) refers to the good news as a revolution, so children should be given the best chance to be smart and healthy contributing members of society by providing them with a truly interdisciplinary, holistic education (Fede, 2012). Creating active students and children will most likely lead to active adults (Williamson et al., 2001), who will reap all the benefits of physical activity creating a healthier and happier world.

CHAPTER THREE: METHODOLOGY

This chapter outlines the methodology used to create a handbook designed for elementary educators that provides movement activities that directly relate to the OSC, supporting the academic, social, emotional, and physical benefits of the mind-body connection. It outlines how the literature was reviewed that was included in the handbook, as well as the needs assessments performed and teacher evaluation that went into creating the final handbook.

Rationale for Methodology: Literature Review

The development of the handbook required an extensive understanding of the current literature available and was conducted in two sections, reviewing the brain-body connection in relation to learning and the implementation of physical activities into classroom lessons. The literature reviewed came from academic sources including edited books as well as journal articles. Many of the journal articles were found using databases such as Academic Search Complete, Academic OneFile, PubMed, and Education Search Complete. The literature was reviewed through title searches, key terms, MeSH terms, and filtered by year and age range. The terms searched included, medical terms such as dopamine, anatomical locations of the brain, and hormones, along with specific title terms for instance, brain-body connection, physical activity benefits on academic performance, and the mind-body connection. The advanced search engine was used to narrow down the literature that focused specifically on the benefits of physical activity on the well-being of elementary and secondary aged students. Studies, articles, and literature was excluded if it was conducted on adults, college or university students, or involved participants that had a mental disability or learning disorder.

The objective of the literature review was to situate this project in a wide body of knowledge (Creswell, 2013). The information that was researched provided background knowledge about the fundamental aspects of the project (the anatomical and physiological connection between the brain and the body, the various benefits of physical activity, the science curriculum, and the theory of learning through movement). A review of current studies completed in these areas was also completed in order to establish an understanding of current intervention strategies as well as best practices. A literature review is also essential for this project in order to identify and meet existing gaps in the literature (Creswell, 2013), in this case, providing educators with information about the brain-body connection and awareness of the benefits in implementing movement activities in the classroom.

A search through the available literature determined a need for the project, as educators are looking for ways to improve their students' academic achievement and implement physical activity into the classroom but are not able to find effective tools that require minimum resources and equipment. This handbook is intended to help educators implement physical activities in their classroom that directly relate to the Ontario curriculum assisting students understanding and academic success. In addition, the activities require minimal resources and can be adapted for cross curricular connections.

To begin the literature review an understanding of the anatomical and physiological connection between the brain and the body was established in order for the rest of the information to be grounded in the fundamentals of the topic. Stemming from the anatomical and physiological connection, academic performance relationship with physical activity was researched in order for a greater depth of understanding to be

provided. The connection between inactivity and academic achievement was explored. Current academic assessment tools as well as intervention programs were examined.

The second section of the literature review revolved around learning through physical movement. This section rooted from Gardner's (1999) theory of multiple intelligences, Dewey's (1938/1991) theory of "learning as inquiry," Dale's (1969) Cone of Experience, and Kolb's (1984) learning theory. Learning by doing has become known as "experiential learning" or "action learning" (Anderson, n.d., p. 1) stating that students retain 90% of what they do or experience in performing a task versus 0-10% of what they read and hear. This places emphasis on the educators to take these theories and put them into practice.

Current literature surrounding the importance of physical activity to youth's overall welling and health was reviewed in order to understand the influence of physical activity at school and at home, as it is a collaborative effort to make our communities a healthier place. The academic subject that would benefit most from physical activities was researched and reviewed. Science was chosen for the handbook as it is the gate-keeper for many university programs (Malekan, 2008), and the concepts seem to be difficult for students to understand, as many of the concepts are abstract (Pedretti & Bellomo, 2014). Physical activities, both individual and group, provide opportunities for students to be creative, use imagination and further develop their understanding of the scientific concepts (Pedretti & Bellomo, 2014).

Finally, in order to connect physical activity and academic learning, pre-existing programs and studies performed that examined physical activity's effect on academic, social, and physical aspects of students were reviewed.

A review of the literature surrounding evidence-based interventions was conducted to understand best practices and available interventions within the school environment. This knowledge is incorporated into the handbook in order to provide educators with evidence and awareness about the benefits of learning through movement, with activities they can implement within the classroom to aid in academic, social and physical improvements.

Research Design: Needs Assessment for the Handbook

The needs assessment research was performed through the "bottom-up" approach, starting with observations and surveys then connecting them to the literature and theories (Creswell, 2013). This was done to gain practical information from the field and then connecting it to the theoretical practices and research, comparing and contrasts what was found in the field and what the literature states. Through the inductive method to research (i.e., having educators express their opinions and rationale about curriculum and mandates), two needs assessments surveys, along with observations, were performed for the handbook which incorporates physical activities into the OSC.

The needs assessments and observations were approved by Brock University's Research Ethics Board (REB), File No. 13-182. The first needs assessment survey addressed educators (teachers) perspective on the mandated DPA policy implemented in 2006. This survey consisted of seven questions (Appendix A), including a space for educators to express questions, concerns or other comments. The second needs assessment survey addressed educators' opinions and thoughts on the OSC and the possibility of implementing physical activity into science lessons. This survey consisted

of five questions (Appendix B) including a space for educators to express questions, concerns or other comments.

These surveys provided information to identify gaps in educator's knowledge and opinions about these topics. The results supply and support the literature review with the information needed to consider in the creation of the handbook, focusing on filling in those gaps and address the needs of the educators.

The teachers were recruited from an Ontario elementary school by the student investigator using a verbal script whereby the study is explained to them. This process was continued until three teachers have been recruited for each survey. Each survey took about 20 minutes to complete. The surveys were dropped off and picked up 2 weeks later, note that no names or grades in which the teacher instructs were expressed. The teachers completed the surveys anonymously and the results of the surveys are only known to the student investigator, primary investigator and the second reader of the Major Research Project. The sole purpose of the needs assessment surveys is to identify teacher gaps in regard to movement-based learning and the DPA policy in order to create a handbook to remedy these gaps. These survey results will never be made public or reported anywhere so there is no risk to the teachers completing the surveys.

One grade 4 science teacher's classroom was observed and three teachers from the same school completed the surveys. The participants received no compensation and there are no risks associated with the research, as outlined in the REB form and inform consent letter (Appendix C). This teacher was approached by the student investigator verbally and had consented to the classroom observations taking place during science lessons. That teacher was provided with the informed consent form (Appendix C). The

parents did not receive a consent form because the research did not affect the children's learning, attention or cause any possible risks. The principal of the school consented to allowing this research to be conducted in the school and this permission was provided to the Brock University's REB.

The teacher whose class was observed was identified by a pseudonym. No students were reported on in this research; therefore pseudonyms for them were unnecessary. In the results the class is addressed as "the grade 4 class." As no student names were collected or reported on, student anonymity can be guaranteed. Only the student investigator was observing the class, and did not speak with anyone but the principal investigator about the observations, and given the small number of people who see the finished research paper, confidentiality is also assured. This was explained to anyone who asked about the study in the school setting. The teacher being observed is the only person in the study who is not anonymous. She was identified only by a pseudonym to protect her confidentiality. Overall, no names are associated with the results.

As the participant in observations, the teacher was asked to precede through their classroom science lessons and while the lessons were under way the student researcher was observing and taking notes related to movement-based learning and overall class engagement.

The student researcher was observing the one elementary teacher, specifically the grade 4 teacher, during science class using the observation guidelines (Appendix D), which included recording information on the time students are active versus passive along with the whole class's perceived level of engagement. The science lesson observations lasted for 8 weeks and took place 3 hours per week; it was broken down into

2 days per week when the students have science in their day cycle. The observations took place in the same classroom every week.

All of the participants in the needs assessments were informed of their right to withdraw from the project through an oral discussion and expressed that the subjects could have withdrawn or decided not to conduct the surveys or observations at any point of the study. If the participant choose to withdraw, there results and data would have been excluded, due to the fact that the research was looking at the results as a whole and not individually.

This research provided knowledge on how the brain-body connection is being nurtured in schools; it allowed educators to see how other educators are implementing DPA into their classrooms, which led to the creation of the resource handbook that aids educators in incorporating movement into their lessons. In conclusion possible benefits of the participation included a more enhanced, detailed and relevant future resource that aids the teachers in implementing movement into the curriculum resulting in improved overall well-being of students.

Data collected during this study was stored with the researcher. Data was kept for the remainder of the researcher's Master's program (August 2014) after which time will be disposed. Access to this data will be restricted to the researcher and the supervisor.

Needs Assessments Evaluations

Needs assessment surveys were conducted regarding professional educators' thoughts and opinions on the OSC and about the mandated DPA. Each needs assessment was completed by three elementary school teachers. The emphasis of the surveys was on the critical analysis of the OSC and DPA mandate, including issues, possible solutions

and suggestions for the future. The survey was dropped off at the elementary school and picked up 2 weeks later, they were anonymous and the estimated time to complete the survey was 20 minutes. The surveys were anonymous, as no name or grade was associated with the data collection.

This section will be summarizing, outlining the common themes, issues, and thoughts about the OSC and mandated DPA from elementary educator's point of view and relating the results to the need for a resource handbook that incorporates movement activity into the curriculum with support from the literature. First, the OSC needs assessment results will be addressed followed by the mandated DPA needs assessment.

Ontario Science Curriculum

All educators stated that there is too many expectations and find that there is a lot of material to cover, which is contradictory to the updated science curriculum that has reduced specific expectations content by 20% (Lambton Kent District School Board, n.d.). An educator states that "I think there is too much to cover when taking all other subjects into account. So, less expectations somewhere, not necessarily from science." A possible solution for this is to create more resources and lessons that are cross-curricular. The educators also would like less technology expectations because they are hard to cover and to access the material or resources needed.

The educators find it hard to come up with really exciting lessons all the time due to the material, lack of resources available and accessibility to these resources (Tsai, 2001). This is congruent with my findings that the OSC assumes the school has the resources for experiments, hands-on activities along with the technology to support it. The updated curriculum improvements have been noticed and are well liked; however

one educator addresses a need to place more emphasis on curriculum that the students can directly relate to. Wellington (2001) addresses this discrepancy within the science curriculum as the tension "between scientific knowledge for its own sake and science education for its utility" (as cited in Malekan, 2008, p. 170); stating that the aim of the science curriculum needs to be on application of science knowledge and not just memorizing or reciting facts. Often the focus in science classrooms has been on teaching learning disciplinary knowledge (Aikenhead, 1994; Roth & Desautels, 2002). Wellington (2001) also states that the focus needs to be on teaching science "for life," which requires establishing scientific skills that are transferable into other areas of learning and in life versus trying or pushing the students into becoming scientists. The updated science curriculum has attempted to address this issue by switching the overall expectation 1 (understanding basic concepts) to 3 and 3 (relating science to society and environment) went to 1, placing a larger value of application skills versus basic concepts. Furthering this notion is the notion for vocational science education that is more 'relevant', fostering the aim of the curriculum to place a higher priority on application skills in which the students can relate to (Wellington, 2001). Keep in mind that the discrepancies between these areas can occur at different levels and to different degrees based on various factors.

With a majority of the educators' time going into planning other subjects like language and math, science does not seem to get as much attention as it should and a possible solution to this is placing science on rotary for all elementary grades. The updated OSC is complex, open-ended, and reinforces science as related to values and applications and not just about knowledge (Pedretti & Bellomo, 2014) and has new and expanded the cross-curricular and integrated learning for program planning aspect

(Lambton Kent District School Board, n.d.). Therefore, the concern that the OSC's expectations are very subjective and that the educators o not have time to plan science lessons could be seen as an opportunity to provide an optimal learning experience as it offers many openings for cross curricular connections, such as language for communication, math for problem solving and probability, health and physical education for human impact/environmental issues and many more. This is one of the great aspects of the science curriculum, which your lesson is not just specifically isolated to science but also includes health and physical education, language, math, and others. Furthermore, research backs that science and language arts have beneficial effects for integrating these disciplines with physical activity (Reed et al., 2010).

In general, all educators would like more resources (or cycling of resources/material) based on the curriculum that provide hands-on lessons with the necessary support. Along with this, they would like to see the concepts covered in lower grades expanded in older grades. However, the OSC was designed as a spiral curriculum, where it builds on knowledge and skills from the previous year. Two of the educators are not seeing this and it may be an area that should be reviewed for the future. This could be attributed to the OSC lack of leadership and vision (Bondar et al., 2007), professional development opportunities are inadequate (Pedretti et al., 2008), and the educators' lack of understanding of OSC education (Pedretti & Bellomo, 2014).

Educators think highly of the idea to incorporate movement activities that directly relate to the OSC, but caution that the activities are not seen as forced and must directly relate to the curriculum. Educators state that this would help students learn and retain different concepts. Physical activities, both individual and group, provide opportunities

for students to be creative, use imagination and further develop their understanding of the scientific concepts (Pedretti & Bellomo, 2014). Active participation, such as role playing also provides students the chance to be creative enhancing their critical thinking, through group and individual learning (Stoll et al., 2006).

Science often becomes abstract, linear, and voids any society, cultural, or political context because the knowledge is just being delivered to students (Pedretti & Bellomo, 2014). When teachers focus on the students just being able to understand and recite basic knowledge without being able to apply, critically think, or problem solve, Freire (2000) describes this teaching method as the "banking method" (p. 86). As most educators agree that the important part in teaching students is getting students involved. Daryl Siedentop (1991) a famed physical educator from Ohio State University, posits that students learn through their involvement with the content. Integration of subject matter allows for more student involvement in the learning experiences.

Students favoured classes that they got to be active and moving in (Jenkins & Heidorn, 2009). Movement and activities in learning are essential aspects in active or inquiry-based teaching that engages students' minds in problem solving and investigation, in which science teachers have long recognized the importance of (Jenkins & Heidorn, 2009). In addition, physical activities will aid in concentration and attention, skills that are crucial when learning content (Budde et al., 2008; Ellemberg & St.-Louis-Deschenes, 2010; Rasmussen & Laumann, 2013; Taras, 2005).

Students have a lot of energy therefore movement activities would be a great idea, however they educators are curious about how these lessons and activities would work; how much room is needed and how would the students respond?

Mandated DPA

The needs assessment results express that DPA is a good idea in theory, but is not always realistic due to the other demands and curriculum. This is the most common reported barrier in implementing DPA, in addition to lack of teacher training, space, and funding (Dwyer et al., 2008; Patton, 2012; Robertson-Wilson & Levesque, 2009). An Ontario principal states "DPA is difficult to deliver when there's already so much pressure to fit other curricula into the day" (Principal, Elementary School, Kawartha Pine Ridge DSB as cited in People for Education, 2013a, p. 14). Notable argument of the strict demands of academic subjects, the time required for DPA take time away from other content areas thereby detracting from academic success, however studies have shown that academic achievement does not suffer when time allotted to academic subjects decrease and physical activity time increases (Ahamed et al., 2007; Lindner, 2002; Trudeau & Shephard, 2008).

All educators agree that DPA is a positive and beneficial mandate as it benefits those who are not the best at sports; it encourages physical movement, makes students more alert and promotes healthy habits. All of the educators acknowledge that there is a lot of curriculum and DPA often gets missed, which is seen in a study that found 45% of educators claimed they "never" have enough time to plan DPA and 65% of teachers state that they "rarely" or "never" conduct follow-up on DPA or physical activity programs (Patton, 2012). However educators state that parents also need to take responsibility and a consistency between home and school is necessary in order to solve the obesity problem, including the children who are unfit that are on the track to an unhealthy life. One educator states that students get plenty of physical activity with recess. Unfortunately this is quite

inaccurate as Canadian kids were found not playing actively in their "free time" at lunch, recess, and after school, resulting in the children only getting 24 minutes of MVPA out of the possible 4 hours (Tremblay et al., 2010) and objectively measured data indicate that only 7% of children and youth are meeting Canada's guidelines of 60 minutes of physical activity a day (AHKC, 2012).

The surveys conclude that DPA should be done, but parents need to assume more responsibility (sending children with unhealthy lunches which do not provide energy in order to play). One educator does find it unreasonable due to the facilities, gym scheduling, and amount of time needed to cover the curriculum. However DPA does not have to be done in the gym, it can be done in the classroom, outside or in the hallways, in which one educator acknowledges and states that DPA is easier to implement in the warmer weather, therefore they tend to follow the mandate more during these months. The educators also make the point that this is a lot of time to spend on non-educational activities and DPA almost seems to be a forgotten thing. A solution to this problem is to incorporate DPA into lessons, which provide direct connections to the curriculum. Again educators' state that the students are getting lots of activity at recess and that educators/teachers/staff should be promoting and encouraging play at recess instead of class time. The Niagara Recess Program has been established, where volunteers provide active, meaningful activities during recess (McNamara, Vaantaja, & Boss, 2013).

Some ideas and strategies that have been suggested by educators were that they try to fit DPA in between subjects, incorporate physical activity through providing many hands-on activities and educating the parents about the mandate to develop a partnership between school and home. Only one educator states that DPA fits perfectly into their

schedule as it can be incorporated into many subjects. The strategy of schools doing DPA at a certain time did not seem to work at this location due to everyone's varying schedules. One of the educators suggests removing the mandate and instead getting schools better equipment/facilities. Their rationale is that kids would play more at recess, for example: if there was soccer nets the kids would play more soccer. In addition, they suggest not allowing cell phones, et cetera outside and teach small groups some games, hoping that it will be picked up by the kids, thinking that this should be a recess thing as the students are outside for one hour a day.

Educators would like more examples of fun DPA and fewer expectations. However all educators state that they use resources for DPA and Patton (2012) concluded that 85% of teacher's state that the resources from OPHEA and other organizations are sufficient and at their disposal. The resources used by the educators were diverse. They use the school resources, their own ideas, DPA games and videos, along with online DPA activities. Educators liked using the different ideas from various resources and found sharing ideas were helpful. Educators found music and movement and games and videos were the most helpful.

Educator Evaluation of the Handbook

The Evolving Mind-Body Alliance handbook was evaluated for effectiveness, clarity, significance, simplicity, and aesthetics by the same sample of participants who completed the needs assessment. Selecting the same participants to evaluate the handbook allowed for educators to assess whether their needs were addressed satisfactorily and whether the handbook would be valuable to elementary school teachers. The evaluation

consisted of reviewing a printed version of the handbook, making notes and comments directly on the draft. The results of the evaluation are delineated in chapter 5

CHAPTER FOUR: PHYSICAL ACTIVITIES INCORPORATED INTO CURRICULUM—A HANDBOOK

The Evolving Mind-Body Alliance

Physical Activities Integrated into the ONTARIO SCIENCE CURRICULUM:

A Handbook for Educators, Schools, & School Boards

Brianna Spratt, M. Ed
Brock University 2014

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Introduction

"The human body, for the last 400,000 years, has primarily been walking, sleeping, leaning, running, doing or squatting. It has not been sitting in chairs." –Eric Jensen, 2000

Purpose

The Evolving Mind-Body Alliance presents this handbook for educators, schools and schools boards that promotes the awareness of the mind-body connection and the importance of learning through movement. This handbook contains movement/physical activities that directly relate to the Ontario science curriculum, focusing on grade 4, where the largest decrease in physical activity lies for females and males (9), aiding in understanding concepts, reviewing knowledge and enhancing the overall wellbeing of the students. These activities can be adapted to meet various grades levels, some ideas are provided on how to adapt the activity for other elementary grades.

Why Incorporate Movement Activities into Science Lessons?

The brain is a complex, extraordinary and powerful muscle that ultimately controls our whole body. The physiological and anatomical link between the brain and the body is far more extensive then the brain strictly being located within the body. Over the years many researchers have established and supported these extensive links between the brain and physical bodily movement, starting with the ancient Greeks (58, 45). When we are physically active our oxygen and blood flow to the brain increases bring more nutrients to the brain, as well as simulates growth and development of brain cells and aids in the release of chemicals that improve cognitive functioning (58). Most importantly, researchers found that the part of the brain that processes movement is the same part of the brain that processes learning (29). Rationale for incorporating movement into the curriculum is addressed through the need for physical activity, the academic benefits, the social, emotional and physical benefits along with the teaching methods and theory behind incorporating movement in the classroom.

Need for Physical Activity

We were born to hunt and gather, relying on physical power and their intelligence to survive, but through evolution our society has engineered movement right out of our lives (46). This is a major threat to our health and ultimately our survival. Canadian Society for Exercise Physiology (CSEP) in 2011 released the new physical activity guidelines, which states:

> *"all healthy children (5-11yrs old) and youth (12-17yrs old) are recommended to get at least 60 minutes of moderate-vigorous physical activity daily (MVPA)"* (CSEP, 2011)

Unfortunately, children and adults all over the world are not meeting the recommended daily physical activity level (48, 34). The Active Healthy Kids Canada Report Card data on physical activity levels in Canadian children remains an F for the 6th consecutive year, as objectively measured data indicate that only **7%** of children and youth are meeting Canada's guidelines of 60 minutes of physical activity a day (1,9).

"Using the body to learn is a simple, readily available, and efficient way for students to learn and remember content" (Kuczala, 2010, p.8).

The percentage of overweight students in our schools has tripled since 1980 due in part to lack of physical activity, and many children are showing early signs of heart disease as young as 5 and 10 years of age (40, 47). Obesity and overweight is known as the "new tobacco" (39) as it is placing students are at a significantly higher risk for developing disease, illness and emotional disorders. This is an increasing epidemic and needs to be addressed and placed on top priority if we want to live a long, healthy life.

Academic Benefits of Physical Activity

Increasing physical activity has been shown to improve students' academic achievement through improved or maintained grades (regardless of less time spend on academic subjects), enhanced capacity for learning through increased and stronger brain cell connections, improved memory, retrieval, attentions, motivation, creativity, decreased sick/absent days and overall improved classroom behaviour and attitude (2, 4, 20, 26, 35, 45, 46). Consequently, "**not implementing a solid PA program you are shortchanging your student's brain and their potential for academic achievement**" (Jensen, 2005, p.67)

When the student physically performs an activity there is an increase of **40%** in retention after two weeks (37, 57). If we can improve student's attention and concentration, then most likely they will be more apt to succeed in learning concepts in the classroom. The more attentive the students are the less likely unwanted behaviours and detractions will arise during the lesson (36). Physical activity has been shown to be the greatest single factor in obtaining the optimal conditions for learning (32, 58).

Emotional, Social & Physical Benefits of Physical Activity

Physical activity contributes to a better learning experience through the enhanced emotional, social and physical development (20). When we are physically active dopamine (a pleasure hormone) pushes outward toward the front of the brain and concentrates in an area, which is absolutely essential state for learning (29).

Physical activities also provide students with the opportunity to build self-esteem, acquire knowledge and skills needed for conflict resolution, decision-making, and communication (27). Having physical activities in the school setting daily will positively affect every student and be less resistant because it is seen as part of their school experience. When a learner is active it allows learners to make mistakes without harmful consequences because of the greater interaction, which leads to less embarrassment and more fun in the school setting, establishing a safe environment (16, 29, 38, 50).

"Children who learn to cooperate, share, and abide by rules of group physical activities and those who learn to discover an test their physical abilities even in individual activities are likely to feel more connected to their school and community and want to challenge themselves" (Tara, 2005, p. 214)

Physical activities programs help children develop social skills, improve mental health, reduce stress, increase arousal/attention, enhance mood and emotional development—all of which may be associated with better academic outcomes (5, 7, 30, 42, 51, 53).

Teaching Methods & Theory of Incorporating Physical Activities into Lessons

Physical activity and bodily movements in learning has been a recognized teaching method since the 1960s with Dale's Cone of Experience (1969). This model and theory states that learners retain more information by what they "do" (90%) as opposed to what is "heard", "read" or "observed" (0-10%). Movement in learning is experiential. By engaging in these activities, learners can construct meaning in a way unique to themselves, incorporating the cognitive, emotional, and physical aspects of learning (41). One of the type of learners are the bodily-kinesthetic learners who "use their whole body to express themselves and have specific physical skills such as, coordination, balance, strength and speed" (20). The University of Illinois found that these types of learners make up about 50% of secondary students, which means that half of our students are not benefiting from learning in a traditional/passive setting (14). In essence, we are all kinesthetic learners. Learning isn't all in our heads, and our brains don't sit disembodied in a bucket. Our mind and bodies work together to help us pay attention, solve problems, and remember solutions (58). Movement and physical activity can enhance optimal learning states (29) and is the preferred way for the brain to acquire information (13, 20, 35).

Physical activity benefits physical and cognitive abilities (8), such as problem-solving, perceptual skills, IQ, academic achievement, verbal tests, mathematics tests, creativity, decision-making, executive functions, speech and developmental level (6, 15, 22, 23, 52). Benefits of physical activity have been shown in all ages, and those who are active as children are more likely to continue to reap the benefits throughout their lives (3, 12, 19, 24, 54, 55, 56). Active play is children's occupation; they grow and develop through physical movement and discovery (44).

Incorporating physical activities into the classroom and curriculum means that you are bringing the material alive to the learners, enhancing engagement, placing concepts in context, and gives purpose to a students' learning (8, 25, 35, 46, 59).

7 Purposes for Incorporating Movement into the Classroom:

1. Preparing the brain: the brain's movement and cognition growth needs to grow and can achieve this through physical activity that stimulates the appropriate systems.
2. Providing brain breaks that are necessary for emotional wellbeing, refocusing the students and brings fun into the lesson.
3. Provide step by step increases
4. Supporting exercise and fitness which combats mood disorders (46), illnesses and diseases.
5. Develops class cohesion and builds relationships, teamwork skills and sense of belonging.
6. Reviewing content using movement allow the students a playful and enjoyable way to review information
7. Teaching new content using movement so that information can be easily accessed and available for later use because of its implicit nature (57, 33)

Conclusion

Your brain and body are integrated as one; they depend and affect each other like a balancing scale. Exercising and being physically active prepares neurons in our brain to connect, strengthens connections, enhances neuroplasticity, and stimulates hormones and proteins in the blood that aid in overall optimal functioning of the brain and body (46). Our muscles, including the brain, become stronger and more flexible the more you use them, therefore the more we can move the superior our brain power can be (46). Exercise strengthens all key areas in the brain (29). All of this supports the notion that our brain and bodies are like the sun and moon; they belong, complement, work together and without one the earth could not function, consequently in order to improve our brains we must move our bodies (58). Treating your body can transform the mind!

Most Common Barrier: **Scheduling Time** (17, 43, 49).
This handbook is addressing the time barrier as the physical activities directly relate to the curriculum and can be incorporated into the lessons. There is no need to try and schedule a separate time for physical activity.
BONUS: Students will benefit academically when provided with opportunities to participate in physical activities.

Misconceptions: Not enough space, equipment, and the risk of injury are too high. However physical activities in the classroom do not always need a lot of space and equipment. This handbook provides activities that can be done inside (class, hallways, gym), outside and with minimal resources. The numerous benefits of physical activities far exceed the risks of implementation; educators just need to be aware of safety hazards when planning the activity.

Considerations

Space*-make sure there is sufficient room*

Safety*- no obstacles*

Effort*-make sure the activities are developmental appropriate (consult a PE specialist)*

Cost & Resources *available*

Overall, **physical activity enriches the learning environment and experience** (20), through the production of transferable skills and understanding, which are the main focus in becoming a well-educated individual. Students are more engaged with ideas and learning if an element of movement was involved (59). Placing concepts in context can scaffold learning toward new ideas, giving purpose to the student's learning. Most important ideas is to expose students to the notion that physical activity is fun and take a first step and try something new, so use more standing than sitting, more walking than standing and more organized activities than walking. The benefits far exceed the risks associated with physical activities, so do not deprive your students of the optimal learning experience, **get moving!**

These movement-based lessons and activities are based upon the expectations pertaining to the grade 4 science curriculum, however ideas to adapt the lessons for other grades, strands and subjects are provided within each lesson. The lessons are not extensively detailed as this provides the educator with more opportunities to adapt and modify the activity to meet the needs of their students.

Handbook Activity Outline

Activity	Curriculum Unit	Specific Expectations	Materials
The Revolutionary Rock, Paper, Scissors	**Rocks & Mineral**	**2.5, 2.6, 3.3, 3.4**	
Mingled Mania	**Light & Sound**	**2.6, 2.7, 3.3, 3.4**	• **Paper or blank cue cards** • **2 boxes**
Match the Meaning/ Writings on the Wall	**ALL**		• **Paper** • **Tape** • **Writing instruments**
Building with Bodies	**Pulleys & Gears**	**2.4, 2.5, 3.5, 3.6, 3.7, 3.8**	
Simon Science Says	**Light & Sound**	**2.7, 3.1, 3.2, 3.3, 3.4, 3.5, 3.7, 3.8**	
Looking in the Mirror	**Light & Sound**	**2.6, 2.7, 3.3, 3.4**	
Walk & Talk	**Habitats & Communities**	**1.1, 2.3, 3.3, 3.7**	
Handy Handshake	**Rocks & Minerals**	**2.5, 2.6, 3.3**	
Embodied	**Habitats & Communities**	**1.2, 2.5, 2.6, 3.7**	
Turn it Up	**Light & Sound**	**2.6, 2.7, 3.4**	

The Revolutionary Rock, Paper, Scissors

3 Classes of Rocks

Sedimentary-flat layers = hands above the head straight like a pin

Igneous –no layers and variable textures=crazy position

Metamorphic- alternating light & dark bands= bend forward

Activity: Students partner up and play Rock, Paper, Scissors now called Sedi, Igneous, Meta.

Educators can decide what term beats the other. They can play as many times are the educator desires and can switch up the partners as frequent as you like. Can even play the game as a class where it is the teacher against the class.

What Beats What:

Metamorphic beats Sedimentary because metamorphic is stronger, as sedimentary rocks tend to be soft and crumble easily.

Sedimentary beats Igneous because sedimentary has more layers than igneous.

Igneous beats Metamorphic because metamorphic grows slower.

Curriculum Connections:

2.5 use appropriate science and technology vocabulary, in oral and written communication
2.6 use a variety of forms to communicate with different audiences and for a variety of purposes
3.3 describe how igneous, sedimentary, and metamorphic rocks are formed
3.4 describe the characteristics of the three classes of rocks and explain how their characteristics are related to their origin

Adaptable Across the Grades:

- Parts of a Plant
- States of Matter
- 3 Types of Levers

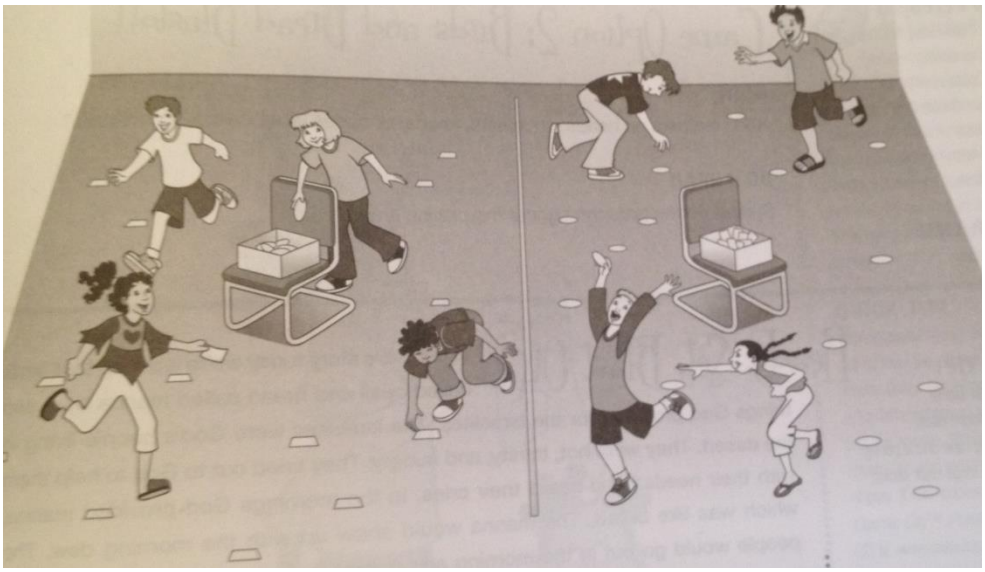
Assessment

★ Anecdotal notes
★ Individual/Group Conferencing

Curriculum Expectation	Expectation Criteria (Look For's)
2.5 use appropriate science and technology vocabulary, in oral and written communication	▪ Children using vocabulary from the unit, such as sedimentary, igneous and metamorphic ▪ Able to explain the movements relation to the rock formation
2.6 use a variety of forms to communicate with different audiences and for a variety of purposes	▪ Use verbal and physical form to communicate their knowledge about rock formation
3.3 describe how igneous, sedimentary, and metamorphic rocks are formed	▪ Orally and/or physically can describe how the rocks are formed, connecting the movements to the specific rock formation process
3.4 describe the characteristics of the three classes of rocks and explain how their characteristics are related to their origin	▪ Use their movements to describe the rocks characteristics and how they are changed/formed into their current being

Mingled Mania

Light & Sound Properties



Activity: Lay out numerous cue cards that have properties of sound or light around the room, on both sides. Divide the students into 2 groups (light and sound). One side of the classroom will be the light and the other the sound. On the educators signal the students will gather one property at a time that attribute to their team, however if the property of your team is on a card that is on the other teams side and you try to go get it, the other team can tag you and you must drop the card and return to your side.

At the end you can go through each team's cards that they collected and as a class decide if they are right or wrong and the rationale for each.

Addition: Can add cards that have examples of light and sound or things that affect light and sound.

Curriculum Connections:

2.6 use appropriate science and technology vocabulary, in oral and written communication
2.7 use a variety of forms to communicate with different audiences and for a variety of purposes
3.3 describe properties of light, including the following: light travels in a straight path; light, can be absorbed, reflected, and refracted
3.4 describe properties of sound, including the following: sound travels; sound can be absorbed or reflected and can be modified

Adaptable Across the Grades:

- Plants & Animals Characteristics/Needs
- Solids & Liquids properties
- Rocks & Minerals
- Human vs Animal Cell

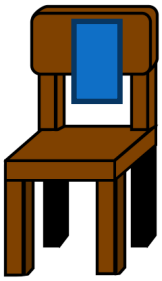
Assessment

- ★ Anecdotal notes
- ★ Group discussions
- ★ Your criteria relating to the curriculum (what you place on the cards)

Curriculum Expectation	Expectation Criteria (Look For's)
2.6 use appropriate science and technology vocabulary, in oral and written communication	▪ Use light and sound vocabulary, such as absorb, reflect, refract, and modify when providing rationale as to why they associated a property to light or sound
2.7 use a variety of forms to communicate with different audiences and for a variety of purposes	▪ Use verbal and physical form to communicate their knowledge about light and sound properties
3.3 describe properties of light, including the following: light travels in a straight path; light, can be absorbed, reflected, and refracted	▪ Orally and/or physically can describe and distinguish properties of light ▪ Placing correct properties into their associated box for light ▪ Provide rationale as to why they decided that property was associated with light
3.4 describe properties of sound, including the following: sound travels; sound can be absorbed or reflected and can be modified	▪ Orally and/or physically can describe and distinguish properties of sound ▪ Placing correct properties into their associated box for sound ▪ Provide rationale as to why they decided that property was associated with sound

Match the Meaning/ Writings on the Wall

1. Match the Meaning



Pulley

A wheel or set of wheels that is used with a rope or chain to lift or lower heavy objects.

2. Writings on the Wall

This activity can be performed in two ways:

Activity 1. Hide cards with terms and definitions around the room. Students then get to look for them and have to match the term with the definition. This would be done as a review for a test or as a summative assessment.

Activity 2. Place terms around the room with big sheets on paper or on the board. Students then get a limited time to go around the room writing their definitions or things about that term that they know. This would be done as a diagnostic assessment and can be reviewed at the end of the unit to see if they were correct.

Addition: Can add cards that have real-world applications, formulas, or impacting elements that the students have to match with the term and definition.

Curriculum Connections:
Can be used for all grades, all strands, and can be cross-curricular.

Assessment

Assessment Type	Criteria (Look For's)
Anecdotal	▪ Match correct term with definition or provide correct definition for term(s) on the wall ▪ Oral or written rationale and examples for why they chose that definition
Diagnostic	▪ What do the students associate with the term
Formative	▪ What areas or terms do students need clarification
Summative	▪ Students can correctly define and explain a science term or process, including examples

Building with Bodies

A Wheelbarrow

A Bicycle

Activity: In partners or groups have students create objects that express the term the educator calls out. Example: Educator says "Lever". The students create a wheelbarrow with their bodies. Discuss each group's creation; get students to guess what others created and why that object is a lever. Option: can attribute points to group that completed the task the quickest, had a great rationale, etc.

As a concluding, you can get the whole class to create an object that is a gear, lever or pulley system, or get the class to spell the word with their bodies.

This is a creative movement activity. Groups of two, three, or four are made. Students build human shapes together. Students are encouraged to lean into each other and support each other (in safe ways). Teacher may have to set parameters and show examples of how to build shapes together. This activity promotes team work and community building as well as promotes creativity and physical expression.

Adaptable Across the Grades:

- Parts of a Plant
- Strong & Stable Structures

Can be used for all grades, all strands, and can be cross-curricular, and includes a drama aspect.

Curriculum Connections:

2.4 use appropriate science and technology vocabulary in oral and written communication
2.5 use a variety of forms to communicate with different audiences and for a variety of purposes
3.5 distinguish between pulley systems and gear systems that increase force and those that increase speed
3.6 identify pulley systems and gear systems are used in daily life, and explain the purpose and basic operation of each
3.7 explain how the gear system on a bicycle works
3.8 identify the input components that drive a mechanism and the output components that are driven by it

Assessment

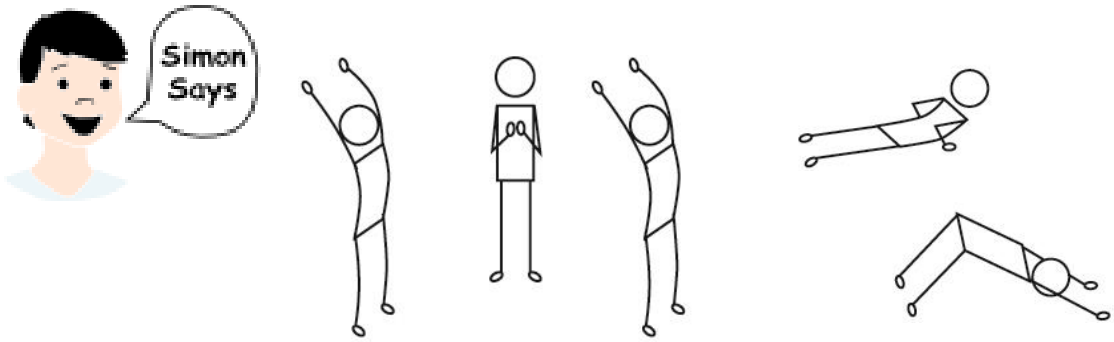
When the students are creating the object, you circulate listening and watching for what the students' are coming up with and how they are coming up with ideas. Anecdotal notes, as well as a checklist of criteria that you will be covering and how the students can earn points. This can be used as a formative assessment to see where the students' understanding is and as a summative.

- ★ Anecdotal notes
- ★ Group discussions
- ★ Formative & Summative

Curriculum Expectation	Expectation Criteria (Look For's)
2.4 use appropriate science and technology vocabulary, in oral and written communication	▪ Use scientific vocabulary when providing rationale as to why they created that item and how they item works
2.5 use a variety of forms to communicate with different audiences and for a variety of purposes	▪ Use verbal and physical form to communicate their knowledge about pulleys and gears
3.5 distinguish between pulley systems and gear systems that increase force and those that increase speed	▪ Can create a lever and explain why it is a lever ▪ Can verbally explain the difference between pulley systems and gear systems
3.6 identify pulley systems and gear systems are used in daily life, and explain the purpose and basic operation of each	▪ Physically create an appropriate and accurate example of pulleys and gears ▪ Orally explain the operation of the item and there purpose
3.7 explain how the gear system on a bicycle works	▪ Group create a bicycle with bodies and then in order to gain a point they explain how the gear system works in a bicycle
3.8 identify the input components that drive a mechanism and the output components that are driven by it	▪ Provide rationale for their creation with bodies and verbally identify the input and output components

Simon Science Says

Light & Sound



Activity: This plays out as normal Simon says. The educator can start as Simon, and then allow students to take over and even break into smaller groups. The educator could say "Simon says: show me how light travels, what light looks like when it refracts, how sound travels, point to something that emits their own light, go touch three things that make sound,…".

Curriculum Connections:

2.7 use a variety of forms to communicate with different audiences and for a variety of purposes
3.1 identify a variety of natural light sources and artificial light sources
3.2 distinguish between objects that emit their own light and those that reflect light from other sources
3.3 describe properties of light
3.4 describe properties of sound
3.5 explain how vibrations cause sound
3.7 distinguish between sources of light that give off both light and heat and those that give off light but little or no heat
3.8 identify devices that make use of the properties of light and sound

Adaptable Across the Grades:

Can be used for all grades, all strands, and can be cross-curricular, however may be a bit too primary for above grade 4.

Assessment

When the students are creating the object, you circulate listening and watching for what the students' are coming up with and how they are coming up with ideas. Anecdotal notes, as well as a checklist of criteria that you will be covering and how the students can earn points. This can be used as a formative assessment to see where the students' understanding is and as a summative game to review the unit.

- ★ Checklist (Appendix A)
- ★ Anecdotal notes
- ★ Group discussions
- ★ Placing the student as Simon
- ★ Diagnostic, Formative & Summative

Curriculum Expectation	Expectation Criteria (Look For's)
2.7 use a variety of forms to communicate with different audiences and for a variety of purposes	▪ Use verbal and physical form to communicate their knowledge about light and sound
3.1 identify a variety of natural light sources and artificial light sources	▪ Can correctly point out light sources when Simon says ▪ Can verbally explain why what they pointed to is a specific source of light
3.2 distinguish between objects that emit their own light and those that reflect light from other sources	▪ Correctly identify objects when Simon says ▪ Orally explain their actions
3.3 describe properties of light	▪ The students response when Simon says describe a property of light
3.4 describe properties of sound	▪ The students response when Simon says describe a property of sound
3.5 explain how vibrations cause sound	▪ Correctly express physically or orally how vibrations cause sound
3.7 distinguish between sources of light that give off both light and heat and those that give off light but little or no heat	▪ Correctly point to variety sources of light
3.8 identify devices that make use of the properties of light and sound	▪ Correctly touch, point or other means identify devices that use sound and light

Looking in the Mirror

Light & Sound

Example: Light travels in a straight line

Activity: In partners, one student will be acting out a light or sound process/property through creation of movements and the other partner will be mirroring their every movement. The movements they perform must express either a process in which light or sound travels or a property of light or sound.

Student A will think of a process or property of light or sound which they would like to physically show. Student A does not tell Student B what the process or property is. Student A and Student B stand face to face. Student A then proceeds with their movement which Student B must mirror. After the movement is complete Student B must guess what Student A was trying to portray and provide a rationale as to why they think it is that process/property. Student A then tells them if they are correct and explains their movement routine and why/how it is showing the process/property.

Addition: You can get each group to share their movements and have the whole class guess. Also you can pick a few movement routines and get the students to teach their movement routine to others. This allows students to be creative and imaginative and provides students with collaboration, high level thinking and application skills that will support them in remembering a concept.

Curriculum Connections:

2.6 use appropriate science & technology vocabulary, including in oral & written communication
2.7 use a variety of forms to communicate with different audiences and for a variety of purposes
3.3 describe properties of light, including the following: light travels in a straight path; light can be absorbed, reflected, and refracted
3.4 describe properties of sound, including the following: sound travels; sound can be absorbed or reflected and can be modified

Adaptable Across the Grades:

This activity can be adapted cross curricular and across the grades for any process or concept the student is trying to understand.

Assessment

Sample Checklist:

- ★ Anecdotal notes
- ★ Oral communication
- ★ Checklist

Checklist

- ☑ light travels in a straight path
- ☑ light can be absorbed
- ☑ light can be reflected
- ☑ light can be refracted
- ☑ sound travels
- ☑ sound can be absorbed
- ☑ sound can be reflected sound can be modified

Curriculum Expectation	Expectation Criteria (Look For's)
2.6 use appropriate science & technology vocabulary, including in oral & written communication	▪ Rationale included appropriate vocabulary within and when explaining their process
2.7 use a variety of forms to communicate with different audiences and for a variety of purposes	▪ Using physical and oral communication to explain and learn about process and properties for light & sound
3.3 describe properties of light, including the following: light travels in a straight path; light can be absorbed, reflected, and refracted	▪ Physical movements provide key information about the property (example: light travels in a straight path- some movement that represents a straight line)
3.4 describe properties of sound, including the following: sound travels; sound can be absorbed or reflected and can be modified	▪ Physical movements provide key information about the property and when the movements are explained, key aspects of the property are mentioned (example: sound can be absorbed- a movement that represents absorption and is mentioned in the rationale about their routine)

Walk & Talk

Habitats & Communities

Activity: Take the students outside for a nature walk around the school. The objective of this activity is for them to walk and talk about habitats, life cycles and food chains that they see. To wrap up the walk, you can sit under a tree or on the grass and discuss the student's discoveries and findings.

Addition: Can address positive and negative impacts of human interactions with natural habitats and communities and what we can do to help preserve the environment and all it contains.

Curriculum Connections:

1.1 analyse the positive and negative impacts of human interactions with natural habitats and communities, taking different perspectives into account and evaluate ways of minimizing the negative impacts
2.3 use scientific inquiry/research skills to investigate ways in which plants & animals in a community depend on features of their habitat to meet important needs
3.3 identify factors that affect the ability of plants and animals to survive in a specific habitat
3.7 describe structural adaptations that allow plants and animals to survive in specific habitats

Adaptable Across the Grades:

- Needs & Characteristics of Living Things
- Daily & Seasonal Changes
- Air & Water in the Environment
- Rocks & Minerals
- Growth & Changes in Animals
- Growth & Changes in Plants
- Biodiversity
- Interactions in the Environment

Assessment

Students can have a worksheet or paper to record their observations that could be handed in for marking. The oral discussion at the end acts as a time for anecdotal notes on the students' findings and rationale.

- ★ Observations (Anecdotal notes)
- ★ Oral communication
- ★ Worksheet (Appendix B)

Curriculum Expectation	Expectation Criteria (Look For's)
1.1 analyse the positive and negative impacts of human interactions with natural habitats and communities, taking different perspectives into account and evaluate ways of minimizing the negative impacts	▪ Identify impact factors on the environment from a human, an animal and a government's point of view ▪ Oral rationale to why these are impact factors and if they are negative or positive
2.3 use scientific inquiry/research skills to investigate ways in which plants & animals in a community depend on features of their habitat to meet important needs	▪ Observations made are related to plants and animals ▪ Walk and discuss plants, animals and habitats ▪ Identify what plants and animals need to survive (made notes about their environment) and providing rationale as to why these habitats are appropriate for the species
3.3 identify factors that affect the ability of plants and animals to survive in a specific habitat	▪ Orally describe factors that affect plant and animal survival, such as sun, shade, water supply, and specifics in the habitat locations
3.7 describe structural adaptations that allow plants and animals to survive in specific habitats	▪ Verbally and written explanation as to how species survive through impact factors and conditions.

Handy Handshake

Rocks & Minerals

Activity: Develop a handshake or dance with verbal words that help you remember a concept, such as how igneous rock is formed.

Example: Igneous rocks: *form when hot, liquid rock from deep below the earth's surface rises towards the surface, cools, and solidifies, for instance, after a volcanic eruption.*

Start crouched in a ball, then slowly rise up with arms waving until you reach the top then grab partners hands and say "Cool" then lower your arms, with your hands still interlocked to chest level. Then fist pump and say "Solid".

1. Start deep below the earth surface 	2. The rising hot liquid from the ground 	3. Reaches the surface 
4. Liquid "Cools" 	5. Solidifies 	

Addition: You can get each group to teach the other groups there handshake and could even lead into a whole class handshake describing all of the rocks formation processes.

This provides students with collaboration, high level thinking and application skills that will support them in remembering a concept.

Curriculum Connections:

2.5 use appropriate science & technology vocabulary, including in oral & written communication
2.6 use a variety of forms to communicate with different audiences and for a variety of purposes
3.3 describe how igneous, sedimentary, and metamorphic rocks are formed

Adaptable Across the Grades:

- Growth & Changes in Animals Life Cycle
- Growth & Changes in Plant Cycle
- Process of How Energy is formed/transferred
- Can be applied to a process in the science curriculum & in other subjects.

Assessment

The oral discussion and vocabulary used in the group's handshake provides an opportunity to assess the students' rationale and comprehension of the formation. In addition, you can assess students' group work skills.

- ★ Anecdotal notes
- ★ Oral communication
- ★ Checklists (Appendix C)

Curriculum Expectation	Expectation Criteria (Look For's)
2.5 use appropriate science & technology vocabulary, including in oral & written communication	▪ Handshake included appropriate vocabulary within and when explaining their process
2.6 use a variety of forms to communicate with different audiences and for a variety of purposes	▪ Using physical and oral communication to explain and learn about rock formations
3.3 describe how igneous, sedimentary, and metamorphic rocks are formed	▪ Handshake provides the key steps in formation of a specific rock

Embodied

Habitats & Communities

A lion in the cave

The sun and other animals

Activity: Place students in groups of 3-4. Each group will pick an animal/plant out of a hat that the class has learnt about. The group will not reveal their animal/plant to any other group. That group will then act out the animal/plant including aspects of their environment. One student in the group must be an "element". This element is something that affects the habitat and/or the species. The group will continue to act out how the habitat and species adapts due to this element. At the end of the skit, the other groups will write down their prediction of what species, habitat and element was acted out. The groups must also provide a rationale for their predictions and come up with a possible solution to reduce the impact of the element.

Another Version: Individually or in groups students will be asked to pick an animal and without words act out that animal and their habitat. Have another student come in as an element, where the students in role must express how they adapt and/or deal with the change and if the element threatens their existence then how they can solve this problem?

Additional: Have other students guess what animal or species they are acting out.

Curriculum Connections:

1.2 identify reasons for the depletion or extinction of a plant or animal species, evaluate the impacts on the rest of the natural community, and propose possible actions for preventing such depletions or extinctions from happening
2.5 use appropriate science & technology vocabulary, including in oral & written communication
2.6 use a variety of forms to communicate with different audiences and for a variety of purposes
3.7 describe structural adaptations that allow plants and animals to survive in specific habitats

Adaptable Across the Grades:

Can be used for all grades, all strands, and can be cross-curricular, plus this activity can be used to acquire drama grades.

Assessment

This provides student's to express their knowledge through role play and to critically think about how factors impact specific habitats. In addition, anecdotal assessment can be performed on students' group work skills, collaboration, and social skills.

Note: Prediction worksheet can be done in groups or individual.

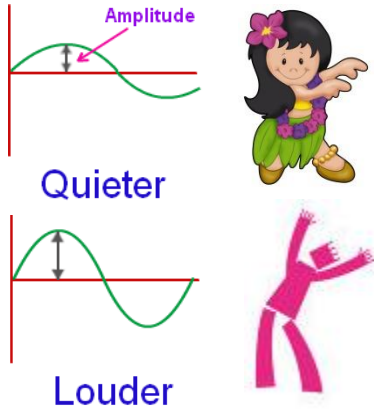
- ★ Anecdotal notes
- ★ Written response/worksheet (Appendix D)
- ★ Oral communication

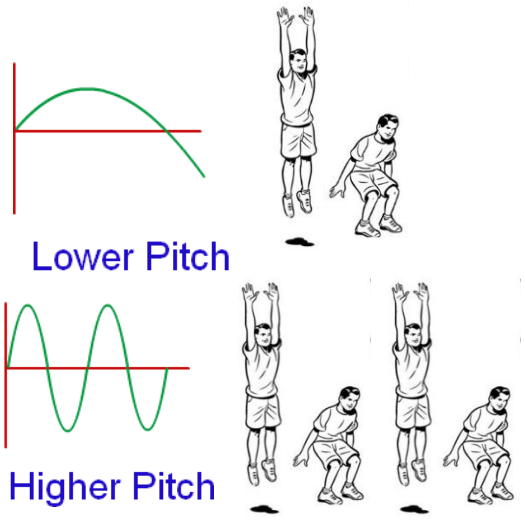
Curriculum Expectation	Expectation Criteria (Look For's)
1.2 identify reasons for the depletion or extinction of a plant or animal species, evaluate the impacts on the rest of the natural community, and propose possible actions for preventing such depletions or extinctions from happening	▪ Able to identify factors affecting the habitat ▪ Creating possible solutions for reducing extinction
2.5 use appropriate science & technology vocabulary, including in oral & written communication	▪ Use scientific vocabulary, such as habitat, and extinction in their verbal or written communication of explaining their role, their act, and when providing solutions for reducing extinction
2.6 use a variety of forms to communicate with different audiences and for a variety of purposes	▪ Using physical, oral and written communication to show and explain habitats and items that impact them
3.7 describe structural adaptations that allow plants and animals to survive in specific habitats	▪ How do they adapt their roles or alter their behaviour to show structural changes in the habitat ▪ Connecting impact factors to adaptations that species must go through to survive ▪ Orally or in writing describe the adaption

Turn It Up

Light & Sound

Review: Sound and light both travel as waves. Sound waves move air molecules and travel a million times slower than light waves. Sound waves can be changed based on their properties (pitch, volume, temperature, etc.).





Activity: The students will be creating the wave that is associated with the sound properties of pitch and volume. Make sure each student has their own space to move. The teacher will call out "Rest" in which the students stop moving (as air molecules do when there is no sound). The teacher will then call out "Turn up the volume a little" the students will then have to create the movement associated with the "loud" wave. The teacher then continues to say "Turn up the volume/pitch" or "Turn down the volume/pitch". The students will alter their movements to correctly express the sound wave. You can discuss why the waves look this way and how it affects our hearing.

Movements

- Rest: molecules at rest (no sound)=no movement
- Pitch: low = one jump into a squat; high= faster and more jump squats
- Volume: loud= little body wave (arms at chest height moving with the hips like the wave-hula dance); louder=big body wave (arms above head)

Curriculum Connections:

2.6 use appropriate science & technology vocabulary, including in oral & written communication
2.7 use a variety of forms to communicate with different audiences and for a variety of purposes
3.4 describe properties of sound, including the following: sound travels; sound can be absorbed or reflected and can be modified

Adaptable Across the Grades:

Any topic of chemistry relating to molecules:
-States of matter (molecules move faster or slower in what state)

Assessment

★ Anecdotal notes on the students association between term and movements
★ Oral communication in the rationale for the movement and waves for that properties

Curriculum Expectation	Expectation Criteria (Look For's)
2.6 use appropriate science & technology vocabulary, including in oral & written communication	▪ Rationale included appropriate vocabulary within and when explaining the wave
2.7 use a variety of forms to communicate with different audiences and for a variety of purposes	▪ Using physical and oral communication to explain the waves associated with the properties of sound
3.4 describe properties of sound, including the following: sound travels; sound can be absorbed or reflected and can be modified	▪ Correct physical movements associated with the teacher's instruction. When the movements and waves are explained, key aspects of the property are mentioned (example: sound can be modified by loudness and we can hear sound through walls because it can be reflected and bend)

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Appendix

Appendix A: Simon Says Checklist

Science Simon Says Checklist

Ideas for Simon for Light & Sound…

"Simon Says…"

- ☑ Point to a source of natural light
- ☑ Point with your leg to a source of artificial light
- ☑ If the classroom light emit their own light jump 3 times
- ☑ Crab walk in the path a light travels
- ☑ Act like you are light and show me what would you reflect off of?
- ☑ Touch the colours that make up white light
- ☑ Raise your hand and tell me how sound is reflected
- ☑ Become sound and show me what you can do (reflect, absorbed, vibrate)
- ☑ Show me how we hear sounds/ how sound travels
- ☑ Touch two sources of light that give off light and heat with your elbow
- ☑ Show me with your body a source of light that gives off light but no heat

Appendix B: Walk & Talk

Nature Walk & Talk Observation Sheet

Make notes on what you SEE, HEAR, & SMELL. Focusing on:

- ☺ Plants: colour, location (shade or sun), why do we need this plant?
- ☺ Animals: what are they doing, why, and when do they come out?
- ☺ Habitats: describe the location of the habitat, if the habitat must change or do change with elements, such as weather?

What are some things that harm these plants and animals?

What can we do to help these species survive?

Appendix C: Handy Handshake Checklist

Handy Handshake Criteria Checklist

Your Handy Handshake must include:

- ☑ Physical movements that relate to the formation process
- ☑ Use appropriate terms during the handshake
- ☑ Use scientific vocabulary to help explain the process
- ☑ Provide key steps in the rock formation
- ☑ Provide an explanation as to why you used those movements and terms

Appendix D: Embodied Worksheet

Group Names: _____

I predict…

- ➔ This group is moving like _____ whose habitat is _____. I think this because_____ _____ _____.
- ➔ The element is _____ because _____ _____ _____.

Possible solution to this element is

_____ _____ _____ _____.

Masters Research Project

Brianna Spratt, M.Ed

Brock University 2014

CHAPTER FIVE: THE CREATION PROCESS—EVALUATION OF THE HANDBOOK, SUMMARY, CONCLUSION, AND IMPLICATIONS

This project began with a comprehensive examination of current literature surrounding awareness of the brain-body connection and importance of learning through movement. Through the literature review it became apparent that brain-body connection is extensive and providing movement in the classroom has numerous benefits for the students. Upon the creation of the first draft, needs assessments were conducted regarding the OSC and the mandated DPA. The needs assessments were performed to gather the data from professionals in the field on the OSC and on the mandated DPA.

After the creation of the first draft of the handbook, three professionals (elementary school teachers) were invited to review the handbook and provide feedback. The teachers were asked to examine, review and provide feedback on the structure, clarity, and practical application of the handbook. The feedback from the professionals provided the project with face validity (Creswell, 2013). This feedback was considered and incorporated into the final version of the handbook.

Teacher Evaluation of the Handbook

Three elementary school teachers reviewed the first draft of this handbook and provided feedback about its structure, clarity, practical application, and overall effectiveness. All feedback received from the professionals was considered and in some instances applied to the final version of the handbook in order to improve the overall product and better meet the needs of parents, children, and teachers.

Comments Regarding Structure

The teachers provided feedback stating, “The handbook was super, some really

neat activities" along with "The handbook was great, really liked the visuals with the activities and it was easy to follow." This feedback suggests that the handbook was on the way to meeting the goal of being easy to use and, presumably, educator friendly but needed some clarity in the explanation of some activities. It was important that the structure and layout of the handbook was easy to follow so that teachers would not be frustrated when using this resource. This is achieved through a variety of means including the division of the handbook into sections, in which each activity has a visual, description, adaptation to other strands and grades, and assessment and curriculum connections.

Positive Qualities of the Handbook

The beginning of the handbook provided "excellent rationale and very interesting facts," as stated in the feedback from the teachers. All the teachers agree with the rationale for incorporating physical activity into the classroom, and acknowledge the vast benefits of it. In addition the beginning of the handbook was easy to understand and clearly outlines the purpose of the handbook. The considerations, misconceptions, and references are outstanding in that it provides evidence and practical applications. The activities in the handbook provide direct curriculum connections as well as tips on how to adapt the activity to other grades or strands. There is assessment for each activity along with some examples of assessment and worksheets in the appendix. One educator states that they want to try some of these activities in their next unit and another stated that they have done two activities similar to ones in the handbook and have worked out fabulous. The greatest quality of the handbook is the numerous opportunities for cross-curricular connections, as teachers find this a key aspect as it is practical because they can achieve

multiple expectations all at once. “Super, love the ideas for cross-curricular,” as expressed by one of the teachers, verifies that the cross-curricular connections aspect of each activity is essential. Overall the handbook provides a resource that is hands-on, highly accessible, requires minimal materials, aids in issues with scheduling separate timing for DPA, and directly related to the OSC, which is greatly desired by professionals in the field.

Handbook Revisions and Future Considerations

After reviewing the handbook, the teachers provided a few specific recommendations that they believe would strengthen it. The first was “To review some of the activities and make sure that they clearly relate to the OSC and to provide a little more description in explaining the activities.” The activities were reviewed and altered to further clarify the direct curriculum connection. In addition, I added an additional worksheet to provide more sample assessment tools to the appendix in order to provide ease of use.

The second recommendation was to “make sure that educators are aware of the safety considerations and some activities would be best conducted outside.” The inclusion of considerations at the beginning of the handbook was included to address this issue; however reminders could be placed throughout the handbook to emphasis safety.

In the future, considerations regarding application of this handbook would include providing accommodations and modifications for students with specific needs. This would improve ease of implementation within a classroom, in which students with specific needs would be included.

Limitations

This project was somewhat limited in scope as the feedback from the professionals came from individuals working in the same school. Furthermore, the teachers who provided feedback about the OSC and the mandated DPA, which included their opinion about having physical activities that directly relate to the curriculum, worked within the same program in the school. Although their work in this program makes these specific individuals qualified to perform the needs assessment, it does not lend itself to providing a range of varied opinions based on differing experiences. As these teachers worked in the same school, they worked with the same students and their experiences are somewhat limited to this small sample of students.

In order to combat this, a larger sample of teachers with a variety of experiences and backgrounds could have been used. A larger sample of professionals would have provided more depth to the feedback collected. With more teachers providing feedback from a greater variety of backgrounds, a wider range of experiences and knowledge could have been incorporated into the review and further development of the handbook.

A next step in this project in order to reduce this limitation would be to gain feedback from educators working in a variety of classroom settings and parents. This feedback would be based on the technical and practical aspects of the handbook and the information within it but focused more on the clarity of the information as well as the practicality and usefulness of the handbook. Such a review would strengthen the utility of the handbook as it would be validated by professionals as well as by end users. The use of standardized and more detailed images and diagrams could also have been employed more throughout the document for greater comprehension. In addition, increased

accessibility to the handbook for educators, school boards, and even parents would be one of the next steps to take.

Implications for Practice

The intention of this project was to create a readily usable handbook intended for educations to help them in providing movement activities that enhance the students understand of science concepts. The handbook is not intended to be an all-inclusive or comprehensive resource for the entire science curriculum. Rather, the handbook activities are encouraged to support and be incorporated into the science curriculum units and lessons. Teacher candidates can also benefit from reviewing this handbook as it provides foundational information and basic instruction in the area of incorporating physical activity into other academic subjects, which highly benefit the students.

The handbook provides movement, visuals, and sample assessments in order to promote academic achievement through the brain-body connection. In this way, the unique design of the handbook offers something that is practical and relevant or educators to use with their students. It is believed that the inclusion of authentic activities was imperious as it made the handbook unique and more accessible than worksheet-based activities.

Finally, community services agencies would be able to benefit from the knowledge and activities in the handbook. This can include librarians, parent educators, and community-run programs. The knowledge of the handbook would allow these professionals to be able to recommend the handbook to parents in order for to gain knowledge regarding the brain-body connection and benefits of movement in the classroom. Also, the community service agencies may be able to incorporate some

activities into their programs to benefit the children. An example of this is "Scientists in the School" and "Mad Science," in which the organizations come into the school and conduct science lessons and experiments. However service agencies that incorporate physical activity and academic learning are scarce.

Implications for Theory

Edgar Dale's (1969) Cone of Experience and Kolb's learning theory serve as the theoretical framework for this project. The theory of learning through doing holds that the human brain retains, remembers and learns more effectively when doing or performing an action (Jensen, 2005). When students can connect a physical experience to the content they can better absorb the information and understand the matters being taught, this is referred to as "experiential learning" (Barduhn, 1998; Dale, 1969; Wood, 2008). Both of these theories state that a human learns more efficiently and effectively when performing a physical movement that relates to the contents. *The Evolving Mind-Body Alliance* handbook not only takes this theory into practice, but also could be used to test the theory's assumption that individuals learn best through doing. It is designed to incorporate physical activities into the science curriculum lessons. By providing these physical activities, according to Dale and Kolb, the students will retain a vast amount more of that science concept. Kolb's learning theory addresses that the learners can construct meaning in a way unique to themselves, incorporating the cognitive, emotional, and physical aspects of learning (Oxendine et al., 2004). The physical activities in the *The Evolving Mind-Body Alliance* handbook include partner, group and individual activities to provide a variety of avenues for the students to learn.

In the handbook, teachers are guided to use the information provided, lesson plans, and activities to assist in implementing physical activity into the subject, specifically science lessons. The importance of physical movement on many aspects of a students and educators life is addressed and provides the essential information, along with many community resources and references. The success of a student relies on the best way that student learns, which according to Kolb and Dale is through doing and experiencing. Therefore, incorporating *The Evolving Mind-Body Alliance* handbook's activities into educators' teaching methods will provide greater opportunity for student success. Important to note is that the teacher and the educational system are only one piece of the puzzle when it comes to implementing physical activities and advancing the overall well-being of a student. It is critical for communities, family and peers to work together in this shared goal of improved well-being.

Discussion

The handbook was specifically designed for educators based on the theoretical framework of Gardner's (1999) multiple intelligence, Kolb's (1984) learning theory and Dale's (1969) Cone of Experience, stating that a majority of students learn best through hands-on activities, physically performances and through movement. Based on Dale's Cone of Experience, students retain 90% of what they do or experience in performing a task versus 0-10% of what they read and hear, however through observations and experiences many educators still rely on reading and answering worksheets in the classroom versus other holistic learning methods. Many educators worry that students will act up and be silly about it if they incorporate physical activity into the classroom and therefore the educators do not want to try it. The research shows that movement

differentiates instruction, increases retention, motivation, attention, and engagement in the learning process (Lengel, & Kuczala, 2010; Ratey, 2008, as cited in Fede, 2012). One of the biggest concerns for increasing physical activity in the classroom and in the school day is the potential loss in time allocated to academic subjects, and the fear that this decrease in time will negatively affect the students' academic grades. The teachers who completed the surveys shared this same concern and would like to have fewer expectations in academic subjects to allow for more time to participate in physical activities.

All the educators were aware of the mandated DPA and expectations, however they do not place it as a high priority most likely due to the lack of awareness of the numerous benefits it has on the students. This is consistent with the research that Stone et al. (2012) performed that found fewer than half of the schools in the GTA provided DPA, not a single child engaged in sustained moderate to vigorous activity for 20 minutes or more, and only 16% of teachers reported never or rarely to conduct DPA (Patton, 2012; People for Education, 2013a). The research correlates with the literature that DPA is being viewed as optional rather than necessary. Through observations and experiences DPA was rarely executed and when it was it was consider physical education or "gym." This lack of implementation is not due to the lack of DPA resources but a lack in time and support from school administrations as 85% of teacher's state that the resources from OPHEA and other organizations are sufficient and at their disposal (Patton, 2012). This is contradictory to the needs assessment survey which revealed that educators would like more resources with fun DPA activities, some that they could do between classes, and within classroom lessons. Another aspect that places DPA low on the priority scale is that

DPA is not assessed, evaluated, or followed up by school boards and physical education associations.

The teachers find that due to the heavy push on numeracy and literacy that physical activity and education gets pushed to the way side. However if the physical activities could relate to the academic subjects then the educators stated that they would be more apt to try them in the classroom as they can justify the activities easier to parents and administrative staff. Wood (2008) performed a study in which she incorporated physical activity into her mathematic lessons, which resulted in positive academic and social outcomes. Educators expressed that they have heard of a few teachers who have incorporated physical activity into the classroom, some of which have loose ties with curriculum however they were mostly for kindergarten level. This has a positive connection with the literature that found only 15% of schools integrate physical activity into other areas of the curriculum (Currie et al., 2012).

Another connection between the literature and the research would be the materials and resources available to educators for the science curriculum. The educators find it hard to come up with really exciting lessons all the time due to the material, lack of resources available and accessibility to these resources (Tsai, 2001). The educators state that resources and kits for science units are hard to access and the circulation of them is limited. Research performed found that the OSC assumes the school has the resources for experiments, hands-on activities along with the technology to support it. Taking this information into consideration the handbook activities were created with minimal materials needed.

Overall a general consensus that creating happy, healthy students is a collaborative effort put forth by schools, communities, and at home. Implementing health habits, such as including physical activity daily, when students are young is essential as they are more likely to grow up to become active adults (Williamson et al., 2001). With the major barrier of implementing DPA being time and scheduling, which educators find they cannot take time away from other subjects due to the large amount of expectation, providing a cross-curricular approach is ideal. Incorporating physical activity into the curriculum provides the students with benefits in academics as well as in personal and physical development. "Research confirms that students perform better in school when they are emotionally and physically healthy. They miss fewer classes, are less likely to engage in risky or antisocial behavior, concentrate more and attain higher test scores" (NASPE, 2011, p. 1). The handbook fills these needs and addresses the issues of implementing physical movement in the school day, enhancing the students', educators', and communities' success.

Future Research

The literature review that was completed in order to develop the handbook reflected research from academic literature including edited books as well as journal articles. Teaching professionals also contributed to the development of the handbook. Further research could involve implementing the activities into a classroom and contacting educators to determine the effectiveness and practicality of the activities. In addition, general as well as specific feedback from more educators about the handbook could be collected in order to ensure that it meets their needs and that the resource is accurately directed towards them. This direct contact and feedback from educators would

ensure that the handbook does exactly what it was designed to do and thereby increase its overall credibility and validity (Creswell, 2013).

Another group that could be consulted to provide a review of the handbook are parent educators and students. This would provide another dimension to the feedback received. Parent educators would be able to provide an evaluation of the practical application, clarity and the overall effectiveness of the handbook, as they are aware of the needs that educators may have that should be addressed in the handbook. Students could provide feedback on their experiences with the activities. This would be beneficial as the students can provide considerations that would enhance the activities, resulting in altering the activities to the students wants. This could lead to more engagement and motivation for students to participate in the activities.

In order to measure the effectiveness of the handbook, a mixed-method study could be conducted which emphasizes the in-depth description and analysis of a shared experience (Creswell, 2013). The study would have a control group, in which educators teach science through unmodified lesson plans and an intervention group, in which the educator would use the handbook activities in their science lessons. Throughout the study, a series of longitudinal interviews would be conducted with educators and students. In addition, participants would be encouraged to share any artefacts that they believe is relevant to their learning experience including personal journals, photos, schoolwork, and educational documents. Analysis of qualitative data (interview transcripts, field notes, artefacts) would consist of coding and categorizing as described by Creswell (2013). The data will be analyzed for themes relating to the primary research

questions. The collected and analyzed data will also undergo a member check to ensure the validity of the research (Creswell, 2013).

Finally, another area that could be further researched in order to improve the handbook is the development of supporting multimedia resources such as instructional videos and interactive on-line programs. This would make the information more accessible to a wider audience including those who prefer to work in other modalities beyond print. In addition this would provide opportunities to conducted studies on how the handbook activities would or could be adapted for students with physical and learning disabilities. Providing an animation of the activities would provide educators with an idea of how the activity would play out. Through the further research suggested, a handbook that is accessible to a wider audience of parents can be developed.

Summary

As humans it is instinctual for us to rely on physical power and intelligence to persist through life. However, through evolution many barriers have caused physical movement to decrease in our lives, endangering the health of humans' physical and mental well-being. There is strong links between the brain and the body, as researchers found that the part of the brain that processes movement is the same part of the brain that processes learning (Jensen, 2005). The process of learning through movement is a recognized and established teaching method (Soltoggio & Lemme, 2013). Edgar Dale (1969) and Kolb's (1984) learning theory give support to this notion that humans learn and retain more information and comprehension when they are learning through movement (doing an activity).

Targeting the youth to increase physical activity will lead to overall healthier adults. Youth spend a majority of their time at school and therefore the school environment is an optimal place to implement more physical movement. Physical movement activities are not a high priority for many school boards and many students do not get the opportunities to be physical active in the school day (Onywera, 2013). The largest barriers to implementing daily physical education is scheduling and the fear of decreasing the students' academic achievement, as the teacher has to take time away from other subjects. Through empirical and theoretical research this fear of students' grades suffering is misleading as the studies have shown that academic achievement does not suffer when time allotted to academic subjects decrease and physical activity time increases (Ahamed et al., 2007; Lindner, 2002; Trudeau & Shephard, 2008). With the scheduling conflicts and decrease time for other curriculum barriers in mind, *The Evolving Mind-Body Alliance* handbook was created for educators, specifically for grade 4, with movement activities that directly relate to the OSC. The focus of the handbook is to promote the awareness of the brain-body connection and importance of learning through movement.

The process of learning through movement activities and their effect on students' academic and personal well-being is a critical topic. Incorporating movement into lessons gives the students purpose and experience to relate back to. Moving and performing activities while learning also promotes social interaction. By using the body students can express their knowledge through the foundational and natural learning process (Burrill, 2011). Providing another way of learning information can reduce stress that children have regarding academic performance, as well as promote healthy self-esteem and body image. Through acknowledging and accepting what the body can do, the students can

become more confident in their abilities. The activities are designed to benefit the students' overall wellbeing in the dimensions of health, as creating a holistic student is the goal for educators.

The needs assessment and observations involved examining current resources being used in the classrooms, exploring teacher's perceptions of what they would like in the handbook, validating the need for the handbook. Inherent to this research study was the exploration of teachers' and students' understanding of movement in learning, expectations for schools, and the relationships that they have with their bodies. Factors that facilitate and/or impeded these activities were also explored, as well as recommendations for movement to be incorporated into the curriculum and there effect on engagement and participation of the students. My handbook resource may help eliminate and address the problem of the rising rate of obese and overweight students because the movement activities directly relate to the curriculum; therefore students are learning and moving all at the same time.

In summary the purpose of this project was to create a resource for educators that promote the awareness of the brain-body connection and importance of learning through movement. Through a review of relevant literature and the feedback and validation from professional teachers, the handbook produced here provides a foundational outline about benefits of movement in learning as well as provides a variety of practical activities that educators can use in their classrooms as the activities directly relate to curriculum. This project is relevant to educators, as it provides a means of incorporating physical and hands-on activities in the classroom that enhance student social, emotional, physical development and academic achievement.

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Appendix A

Daily Physical Activity Needs Assessment Survey

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1. What is your opinion on the mandated daily physical activity (DPA) set out by the government since 2006?

2. Do you think this mandate is unreasonable? Why?

3. How often/much do you follow the mandate? Explain. *Remember this is confidential; no names will be associated with any answers and this is only be used to inform the creation of a handbook for teachers on movement-based activities and the daily physical activity policy.*

4. If you could change the mandate, what would you change and why?

5. What would help you, as an educator, to implement the mandated DPA?

6. Do you use any resources? Are they helpful? What would make them better?

7. Any other comments, concerns or statements?

Appendix B

Ontario Science Curriculum Needs Assessment Survey

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1. What is your overall view and outlook on the Ontario science curriculum?

2. What would like to see more of in the science curriculum? Why?

3. What would you like to see less of?

4. What is your opinion on having movement activities in the classroom that would directly relate to the science curriculum? Provide details and explanations for your perspective.

5. Any other comments, concerns, or statements?

Appendix C

Informed Consent Letter

Date: **January 2014**

Principal Student Investigator: Brianna Spratt, MEd Candidate
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INVITATION

You are invited to participate in a study that involves research. The purpose of this study is to investigate, observe, gain perspectives and knowledge on the feasibility and impact of my Master's research resource, The Evolving Mind-Body Alliance. This will involve observations of current resources being used in the classrooms, exploring student and teacher perceptions of what they would like in the handbook, concluding the need and rationale for this handbook. Inherent to this research study is the exploration of teachers' and students' understanding of movement in learning, expectations for schools, and the relationships that they have with their bodies. Factors that facilitate and/or impede these activities will also be explored, as well as recommendations for movement to be incorporated into the curriculum affecting engagement and participation.

WHAT'S INVOLVED

As a participant, you will be asked to proceed through your classroom science lessons and while the lessons are under way the researcher will be observing and taking notes related to the time students are active or passive and the extent to which the entire class is engaged in the lesson. Participation will take 8 weeks for 3 hours a week (split into two 1.5 hour sessions per week). Three teachers will be asked to complete a survey form to express their perspective on the mandated daily physical activity implemented by the government in 2005 and on the Ontario science curriculum. The survey takes approximately 20 minutes to complete. The responses to the surveys will be used to create a handbook for teachers on movement-based learning activities for science and the daily physical activity policy.

POTENTIAL BENEFITS AND RISKS

This research will provide knowledge on how the brain-body connection is being nurtured in schools, that it will allow educators to see who other educators are implementing DPA into their classrooms, and that it will lead to a handbook of resources being created to aid educators in incorporating movement into their lessons. In

conclusion possible benefits of participation include a more enhanced, detailed and relevant future resource that will aid the teachers in implementing movement into the curriculum resulting in improved overall well-being of students. There are no known or anticipated risks associated with participation in this study.

CONFIDENTIALITY

All information you provide is considered confidential; your name will not be included or, in any other way, associated with the data collected in the study. Furthermore, because our interest is in the general responses and themes that emerge from the surveys and through the observations of the entire group of participants, you will not be identified individually in any way in written reports of this research. Data collected during this study will be stored with the researcher. Data will be kept for the remainder of the researchers Masters work (August 2014), after which time will be disposed. Access to this data will be restricted to the researcher and the supervisor.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study. Further, you may decide to withdraw from this study at any time and may do so without any penalty or loss of benefits to which you are entitled.

DISSEMINATION OF RESULTS

Results of this study will be reported in a paper submitted to the supervisor and in a handbook created by the student researcher. Feedback about this study will be available through the student researcher.

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please contact Brianna Spratt or Michael Savage using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University [insert file #]. If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at (905) 688-5550 Ext. 3035, reb@brocku.ca.

Thank you for your assistance in this project. Please keep a copy of this form for your records.

CONSENT FORM

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

Name: _____

Signature: _____ Date: _____

Appendix D

Observation Guidelines

All science lessons will be observed by the researcher, who will be located at the back of classroom taking notes during the lesson(s) and will not be accessing any school record of the participants throughout the study.

Date	**Lesson Activity**	**Active time** (mins)	**Passive time** (mins)	**Level of Student Engagement** (1-10)	**Comments/Notes**